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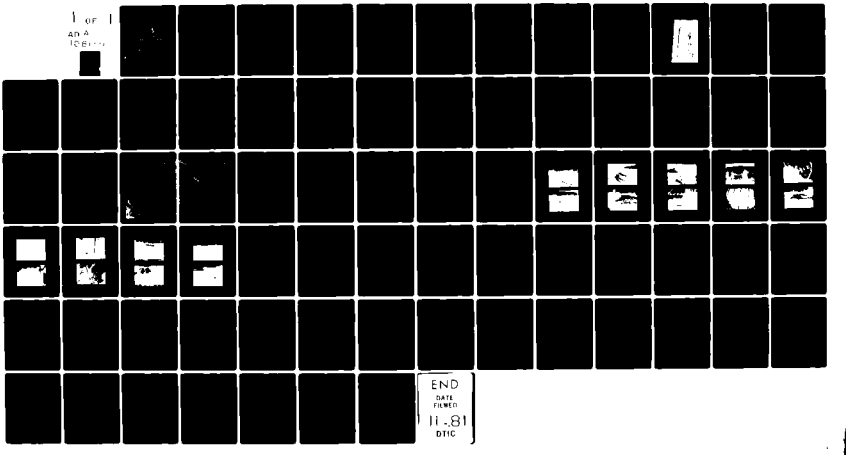

MISSOURI-KANSAS CITY BASIN

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LEVEL II

UPPER DONIPHAN DAM
RAY COUNTY, MISSOURI
MO 12091

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PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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MISSOURI-KANSAS CITY BASIN

UPPER DONIPHAN DAM

RAY COUNTY, MISSOURI

MO 12091

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
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St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT. ST. LOUIS

FOR: STATE OF MISSOURI

DECEMBER 1980

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

SUBJECT: Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Upper Doniphan Dam MO 12091.

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

a. Spillway will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.

b. Overtopping of the dam could result in failure of the dam.

c. Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED
Chief, Engineering Division — 28 APR 1981 (Date)

APPROVED BY: SIGNED
Colonel, CE, District Engineer — 29 APR 1981 (Date)

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UPPER DONIPHAN DAM

RAY COUNTY, MISSOURI

MISSOURI INVENTORY NO. 12091

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY:

BLACK & VEATCH
CONSULTING ENGINEERS
KANSAS CITY, MISSOURI

UNDER DIRECTION OF

ST. LOUIS DISTRICT CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

DECEMBER 1980

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Upper Doniphan Dam
State Located	Missouri
County Located	Ray County
Stream	Lick Creek
Date of Inspection	2 December 1980

Upper Doniphan Dam was inspected by a team of engineers from Black & Veatch, Consulting Engineers for the St. Louis District, Corps of Engineers. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and state agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. According to the St. Louis District, Corps of Engineers, failure would threaten lives and property. The estimated damage zone extends approximately four miles downstream of the dam. Within the estimated damage zone are nine camp cabins, a sewage lagoon and Lake Doniphan (Mo. Id. 10589). Contents of the estimated downstream damage zone were verified by the inspection team.

Our inspection and evaluation indicates the spillways do not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillways will not pass the probable maximum flood without overtopping but will pass 15 percent of the probable maximum flood. The spillways will pass the flood which has a one percent chance of occurrence in any given year (100-year flood). The spillway design flood recommended by the guidelines is 50 to 100 percent of the probable maximum flood. Considering the hazard zone, the spillway design flood should be 100 percent of the probable maximum flood. The probable maximum flood is defined as the flood discharge which may be expected from the most severe combination of critical meteorologic and hydrologic conditions which are reasonably possible in the region.

Based on visual observations, this dam appears to be in good condition. Deficiencies visually observed by the inspection team were erosion and sloughing of the upstream slope at the waterline due to wave

action, and animal burrows in the embankment. Seepage and stability analyses required by the guidelines were not available.

There were no observed deficiencies or conditions existing at the time of the inspection which indicated an immediate safety hazard. Future corrective action and regular maintenance will be required to correct or control the described deficiencies. In addition, detailed seepage and stability analyses of the existing dam, as required by the guidelines, should be performed. A detailed report discussing each of these deficiencies is attached.

Edwin R. Burton, PE
Missouri E-10137

Harry L. Callahan, Partner
Black & Veatch

OVERFLOW OF DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
UPPER DONIPHAN DAM

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SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the District Engineer of the St. Louis District, Corps of Engineers, directed that a safety inspection of Upper Doniphan Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed with the help of several Federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is an earth structure located in the valley of Lick Creek. (see Plate 1). The watershed is an area of low hills consisting of about 15 percent urban development, 15 percent cropland, 15 percent timber, and 55 percent grassland. There is a golf course, airport runway, and residential development in the watershed. A dam is under construction on the golf course upstream of Upper Lake Doniphan which will supply irrigation water. The dam is approximately 470 feet long along the crest and 22 feet high. The dam crest is 13 feet wide. The crest has a straight alinement and is covered with gravel. The downstream face of the dam slopes from the crest to a 17-foot wide berm and then to the valley floor below (Plate 4, Photo 6).

(2) The principal spillway is a 5-foot diameter corrugated metal pipe drop inlet with a 3-foot diameter corrugated metal pipe outlet pipe. The drop inlet is located near the west end of the dam. The flow through the spillway is controlled by water surface levels. A hemispherical trash rack about two feet high is set across the drop inlet (Photo 7). The spillway pipe discharges to a plunge pool and then into Lake Doniphan.

(3) The emergency spillway is an ungated overflow section located at the right abutment along the extension of the centerline of the dam. The approach channel to the control section is a grass lined channel. The spillway channel is grass lined and discharges are kept away from the embankment by a dike located on the left bank of the spillway channel. Flows from this spillway enter Lake Doniphan downstream from the toe of Upper Doniphan. There is no development in the immediate spillway area.

(4) Pertinent physical data are given in paragraph 1.3.

b. Location. The dam is located in southwest Ray County, Missouri, as indicated on Plate 1. The lake formed by the dam is shown on the United States Geological Survey 7.5 minute series quadrangle map for Excelsior Springs, Missouri in Section 7 of T52N, R29W.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, the dam and impoundment are in the small size category. A small size dam is classified as having a height less than 40 feet, but greater than or equal to 25 feet and/or a storage capacity less than 1,000 acre-feet, but greater than or equal to 50 acre-feet.

d. Hazard Classification. The hazard classification assigned by the Corps of Engineers for this dam is as follows: Upper Doniphan Dam has a high hazard potential, meaning that the dam is located where failure may cause loss of life, and serious damage to homes, agricultural, industrial and commercial facilities, and to important public utilities, main highways, or railroads. For Upper Doniphan Dam the estimated flood damage zone extends approximately four miles downstream of the dam. Within the estimated damage zone are nine camp cabins, a sewage lagoon, and Lake Doniphan (Mo. Id. 10589). Contents of the estimated downstream damage zone were verified by the inspection team.

e. Ownership. The dam is owned by Center Place Campgrounds, Inc., 200 N. Delaware, Independence, Mo. 64050, Attention: Mr. O.C. Henson.

f. Purpose of Dam. The dam forms an 10.6-acre lake used for recreation.

g. Design and Construction History. Data relating to the design and construction were not available.

h. Normal Operating Procedure. Normal rainfall, runoff, transpiration, evaporation, and overflow through the uncontrolled drop inlet spillway all combine to maintain a relatively stable water surface elevation.

1.3 PERTINENT DATA

a. Drainage Area - 257 acres, 102 acres uncontrolled.

b. Discharge at Damsite.

(1) Normal discharge at the damsite is through a 5-foot diameter corrugated metal pipe drop inlet spillway.

(2) Estimated experienced maximum flood at damsite - Unknown.

(3) Estimated ungated spillway capacity at maximum pool elevation 1,040 cfs (Probable Maximum Flood Pool El. 897.2).

c. Elevation (Feet above m.s.l.).

(1) Top of dam - 894.0 (see Plate 3)

(2) Emergency spillway crest - 893.5

(3) Principal spillway crest - 889.9

(4) Streambed at toe of dam - 872.2

(5) Maximum tailwater - 871.0 (Spillway crest elevation of lower dam)

d. Reservoir.

(1) Length of maximum pool - 1,720 feet ± (Probable maximum flood pool level)

(2) Length of normal pool - 1,390 feet ± (Principal spillway crest)

e. Storage (Acre-feet).

(1) Top of dam - 110

(2) Emergency spillway crest - 104

(3) Principal spillway crest - 63

(4) Design surcharge - Not available.

f. Reservoir Surface (Acres).

(1) Top of dam - 12.5

(2) Emergency spillway crest - 12.3

(3) Principal spillway crest - 10.6

g. Dam.

(1) Type - Earth embankment

(2) Length - 467 feet

(3) Height - 22 feet ±

(4) Top width - 13 feet

(5) Side slopes - upstream face between 1.0 V on 1.3 H and 1.0 V on 3.9 H, downstream face between 1.0 V on 2.5 H and 1.0 V on 13.1 H (see Plate 4).

(6) Zoning - Unknown.

(7) *Impervious core - Unknown.*

(8) Cutoff - Unknown.

(9) Grout curtain - Unknown.

h. Diversion and Regulating Tunnel - None.

i. Principal Spillway.

(1) Type - 5-foot diameter corrugated metal pipe drop inlet with trash rack with discharge through 3-foot diameter corrugated metal pipe.

(2) Drop inlet crest elevation - 889.9 feet m.s.l.

(3) Drop inlet invert elevation - 884.3 feet m.s.l.

(4) 3-foot diameter corrugated metal pipe outlet invert - 873.4 feet m.s.l.

(5) Gates - None.

(6) Upstream channel - None.

(7) Downstream channel - Discharges to a plunge pool and then to Lake Doniphan.

j. Emergency Spillway

(1) Type - Grass lined channel with weir control section.

(2) Crest elevation - 893.5 feet m.s.l.

(3) Channel width - 60 feet.

(4) Gates - None.

(5) Upstream channel - Grass lined approach channel.

(6) Downstream channel - Spillway channel at west end of embankment and discharges into Lake Doniphan downstream of the toe of Upper Doniphan Dam.

k. Regulating Outlets - None.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Design data were not available.

2.2 CONSTRUCTION

Construction records were unavailable. The dam was constructed between 1957 and 1975 as determined from the USGS topographic map update in 1975.

2.3 OPERATION

Operational records and documentation of past floods were unavailable.

2.4 GEOLOGY

The dam is located across a broad, shallow valley that was formed by Lick Creek. The soil of the dam and the reservoir area consists of silty clay (CL) developed in loess. For engineering purposes these soils are classified as silty clays (CL). Bedrock of the area consists of interbedded limestone and shale of the Pennsylvanian age Kansas City Group.

The foundation of the dam is on alluvial silty clay overlying shale bedrock at an unknown depth. The right and left abutments consist of silty clay (CL) developed in loess overlying limestone and shale bedrock. The emergency spillway is cut through the same material overlying limestone bedrock.

2.5 EVALUATION

a. Availability. No engineering data were available.

b. Adequacy. No engineering data were available. Thus, an assessment of the design, construction, and operation could not be made. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity. The validity of the design, construction, and operation could not be determined due to the lack of engineering data.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of Upper Doniphan Dam was made on 2 December 1980. The inspection team consisted of Edwin Burton, team leader; Shannon Casey, geologist; Gary Van Riessen, geotechnical engineer; Harvey Coppage, civil engineer and Thomas Rutherford, hydrologic-hydraulic engineer. The dam appeared to be in good condition. Specific observations are discussed below. No observations were made of the condition of the upstream face of the dam below the pool elevation at the time of the inspection.

b. Dam. The inspection team observed the following conditions at the dam. No cracking, sliding, sloughing or other signs of instability or settlement were observed. No toe drains or relief wells were observed.

The dam crest has a grass and gravel road cover with some worn spots, probably due to foot and vehicle traffic. Wave action erosion was observed on the upstream slope. There is no riprap protection for this dam.

Some sloughing of embankment material was observed in areas subjected to wave erosion.

No evidence was found to indicate that the embankment had ever been overtopped.

There was evidence that a maintenance program was in effect which includes mowing of the crest grass. A few animal burrows were observed on both the downstream and upstream slopes.

c. Appurtenant Structures. The inspection team observed the following items pertaining to the appurtenant structures. The principal spillway is a 5-foot diameter corrugated metal pipe drop inlet with a hemispherical trash rack and is located near the west end of the embankment. The drop inlet discharges to a 3-foot diameter corrugated metal pipe. The spillway was considered to be in good condition. It should be noted that an abnormally large principal spillway discharge would probably not damage the embankment due to its direct discharge into Lake Doniphan. Some minor erosion has taken place under the outlet end of the spillway pipe.

The emergency spillway is a grass lined channel cut in the area of the right abutment. There is a controlling overflow section along the extension of the centerline of the dam. Spillway discharges are kept from the embankment by a built up dike. The channel was considered in good condition.

There was no development in the spillway areas which would suffer damage due to flow through the spillways.

d. Geology. The soil in the area of the dam and reservoir consists of silty clay developed in loess. Depth of the limestone and shale bedrock is unknown.

The emergency spillway is cut into silty clay overlying limestone which is covered so no bedding or jointing could be observed.

A sample from the embankment was taken from the crest and consisted of silty clay material. Based on visual observation, it is assumed that the entire embankment is constructed of this silty clay material.

The abutments and foundation of the dam are silty clay material overlying limestone and shale.

e. Reservoir Area. No slumping or slides of the reservoir banks were observed. The upstream channel to the lake contains some minor debris and a few trees. There is a small irrigation water supply dam under construction in the upper watershed. The lake was noted to be clean with no siltation.

f. Downstream Channel. The principal spillway discharges to a plunge pool, and then to Lake Doniphan. The emergency spillway channel discharges to Lake Doniphan.

3.2 EVALUATION

The various deficiencies observed at the time of the inspection are not believed to represent an immediate safety hazard. They do, however, warrant monitoring and control.

The absence of riprap on the upstream slope of the dam has resulted in wave action erosion and sloughing of embankment material. If not corrected wave action will continue to erode the embankment and could lead to slope stability problems.

Burrowing animals will continue to damage the embankment if a program is not undertaken to eliminate them. Piping failure of embankments have resulted from damage caused by burrowing animals.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The pool is primarily controlled by rainfall, runoff, evaporation, transpiration, and capacity of the uncontrolled drop inlet spillway.

4.2 MAINTENANCE OF DAM

There was evidence that a maintenance program was in effect which includes the mowing of the crest grass.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no existing warning system or preplanned scheme for alerting downstream residents for this dam.

4.5 EVALUATION

A maintenance program should continue to include mowing the grass cover on the embankment in order to discourage animal burrowing.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No design data were available.

b. Experience Data. The drainage area and lake surface area are developed from USGS Excelsior Springs Quadrangle Map. The dam layout is from a survey made during the inspection.

c. Visual Observations.

(1) The principal spillway appears to be in good condition. The lake level at the time of the inspection (El. 888.5) was below the principal spillway crest level. There were no obstructions to flow in the downstream channel.

(2) There is an emergency spillway for this dam. It appears to be in good condition. There were no obstructions to flow in the spillway channel.

(3) Spillway discharges do not endanger the integrity of the dam.

d. Overtopping Potential. The spillways will not pass the probable maximum flood without overtopping the dam. The probable maximum flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The spillways will pass 15 percent of the probable maximum flood without overtopping the dam. The spillways will pass the one percent chance flood estimated to have a peak outflow of 154 cfs developed from a 24-hour, one percent chance rainfall. According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, a high hazard dam of small size should pass 50 to 100 percent of the probable maximum flood. Considering the downstream hazard, the appropriate spillway design flood should be 100 percent of the probable maximum flood. The portion of the estimated peak discharge of 50 percent of the probable maximum flood overtopping the dam would be 1,130 cfs of the total discharge from the reservoir of 1,800 cfs. The estimated duration of overtopping is 4.9 hours with a maximum height of 2.3 feet. The portion of the estimated peak discharge of the probable maximum flood overtopping the dam would be 3,520 cfs of the total discharge from the reservoir of 4,560 cfs. The estimated duration of overtopping is 6.9 hours with a maximum height of 3.2 feet. The embankment could be jeopardized should overtopping occur for these periods of time.

The hydraulic analysis for Upper Doniphan Dam includes the results of a breach analysis for the upstream dam under construction.

According to the St. Louis District, Corps of Engineers, the effect from rupture of the dam could extend approximately four miles downstream of the dam. Nine camp cabins, a sewage lagoon, and Lake Doniphan Dam could be severely damaged and lives could be lost should failure of the Upper Doniphan Dam occur. Contents of the estimated downstream damage zone were verified by the inspection team. There does not appear to be any flood plain regulations or other constraints in force to limit future downstream development.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of conditions which affect the structural stability of this dam are discussed in Section 3, paragraph 3.1b.

b. Design and Construction Data. No design data relating to the structural stability of the dam were found. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Operating Records. No operational records exist.

d. Postconstruction Changes. No postconstruction changes were evident.

e. Seismic Stability. The dam is located in Seismic Zone 1 which is a zone of minor seismic risk. A properly designed and constructed earth dam using sound engineering principles and conservatism should pose no serious stability problems during earthquakes in this zone. The seismic stability of an earth dam is dependent upon a number of factors: embankment and foundation material classifications and shear strengths; abutment materials, conditions, and strengths; embankment zoning; and embankment geometry. Adequate descriptions of embankment design parameters, foundation and abutment conditions, or static stability analyses to assess the seismic stability of this embankment were not available and therefore no inferences will be made regarding the seismic stability. An assessment of the seismic stability should be included as part of the stability analysis required by the guidelines.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. Several conditions observed during the visual inspection by the inspection team should be monitored and/or controlled. These are erosion and sloughing on the upstream slope and animal burrows in the embankment. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

b. Adequacy of Information. Due to the absence of engineering design data, the conclusions in this report were based only on performance history and visual conditions. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency. It is the opinion of the inspection team that a program should be developed as soon as possible to implement remedial measures recommended in paragraph 7.2b. If the safety deficiencies listed in paragraph 7.1a are not corrected, they will continue to deteriorate and lead to a serious potential of failure. The item recommended in paragraph 7.2a should be pursued on a high priority basis.

d. Necessity for Phase II. The Phase I investigation does not raise any serious questions relating to the safety of the dam nor does it identify any serious dangers which would require a Phase II investigation. However, the additional analyses noted in paragraph 2.5b are necessary for compliance with the guidelines.

e. Seismic Stability. This dam is located in Seismic Zone 1. Adequate description of embankment design parameters, foundation and abutment conditions, or static stability analyses to assess the seismic stability of this embankment were not available and therefore no inferences will be made regarding the seismic stability. An assessment of the seismic stability should be included as part of the recommended stability analysis.

7.2 REMEDIAL MEASURES

a. Alternatives. Spillway capacity and/or height of the dam would need to be increased or the lake level would need to be permanently lowered to increase available flood storage in order to effectively pass the spillway design flood. The storage volume could be increased by raising the low areas of the dam crest to a level equal to the observed maximum elevation or by raising the entire dam crest.

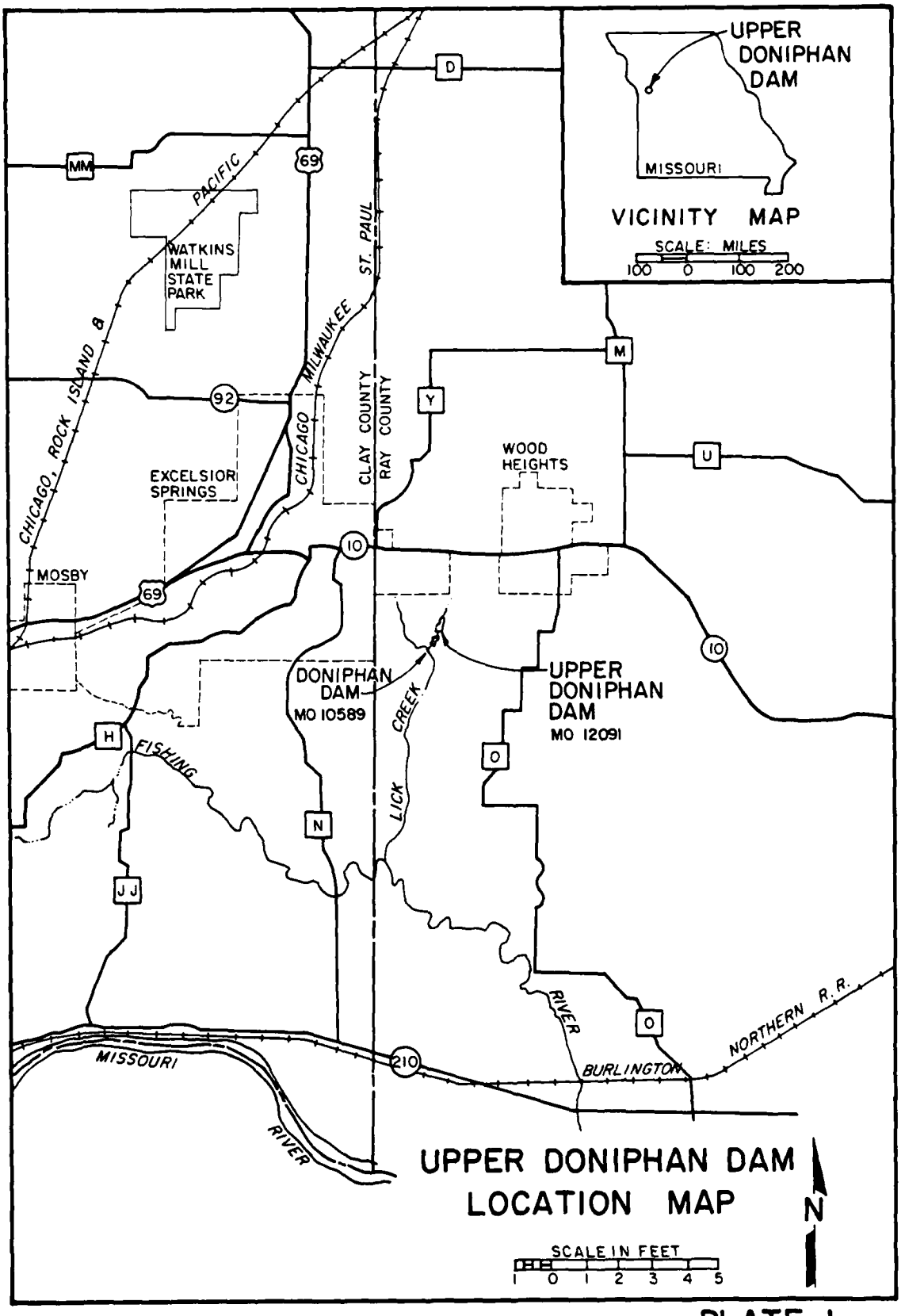
b. Operation and Maintenance Procedures. The following operation and maintenance procedures are recommended and should be carried out under the direction of a professional engineer experienced in the design, construction, and maintenance of earth dams.

(1) Riprap should be placed on the upstream face of the dam to an elevation above the normal lake level to prevent erosion and sloughing of the embankment material.

(2) The animal burrows in the embankment should be repaired since they can lead to piping. Control measures should be implemented to discourage animal activity in the area. The embankment slope should be monitored by a qualified engineer during repair of the embankment.

(3) Seepage and stability analyses should be performed.

(4) A detailed inspection of the dam should be made periodically. More frequent inspections may be required if additional deficiencies are observed or the severity of the reported deficiencies increase. Results of the recommended inspection should be documented and made a matter of record.


UPPER DONIPHAN DAM
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PACIFIC
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MILWAUKEE
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CHICAGO
CLAY COUNTY
RAY COUNTY
WATKINS MILL STATE PARK
EXCELSIOR SPRINGS
MOSBY
WOOD HEIGHTS
DONIPHAN DAM
MO 10589
UPPER DONIPHAN DAM
MO 12091
LICK CREEK
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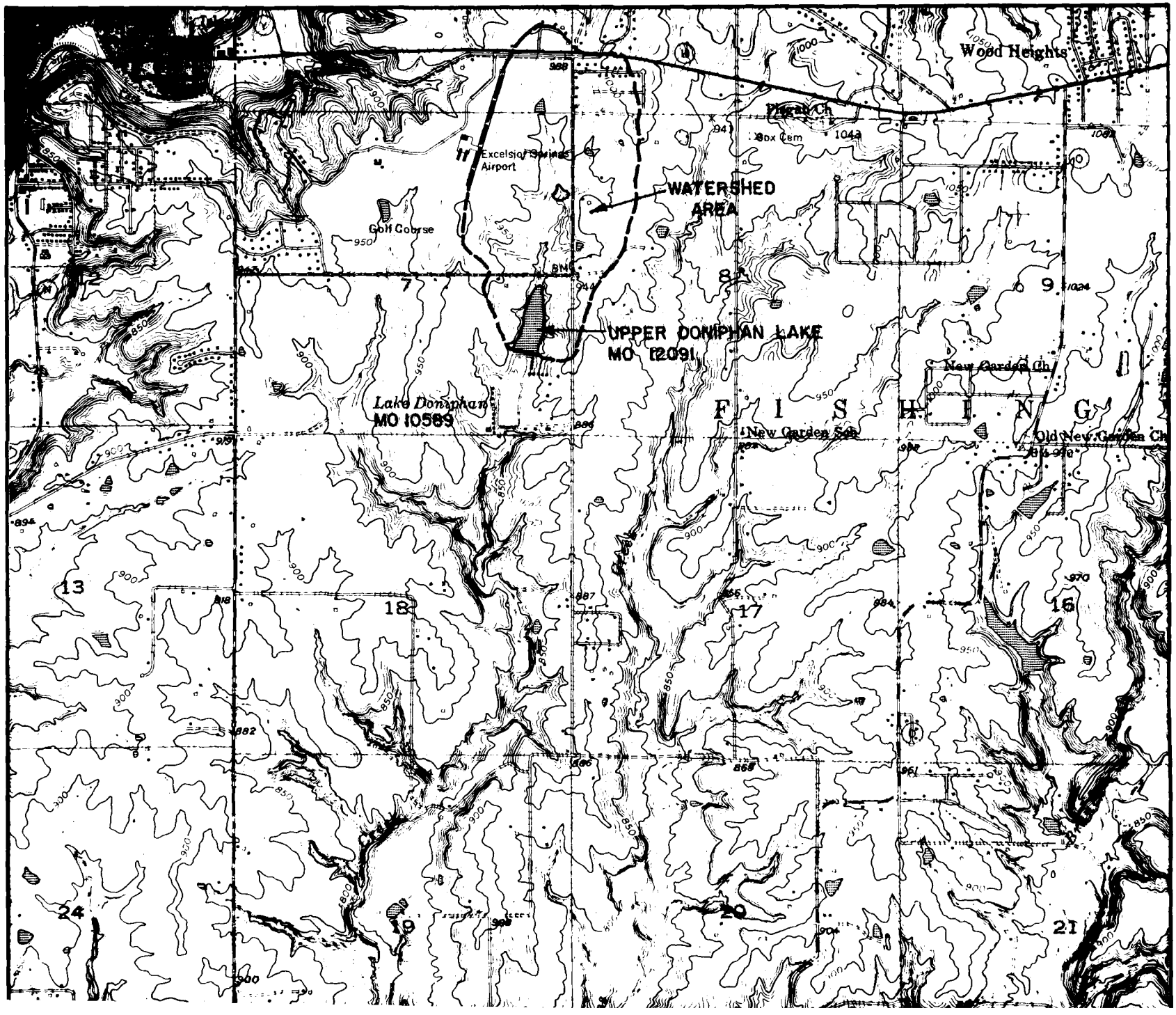
PLATE 1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WATERSHED AREA
Golf Course
UPPER DONIPHAN LAKE MO 12091
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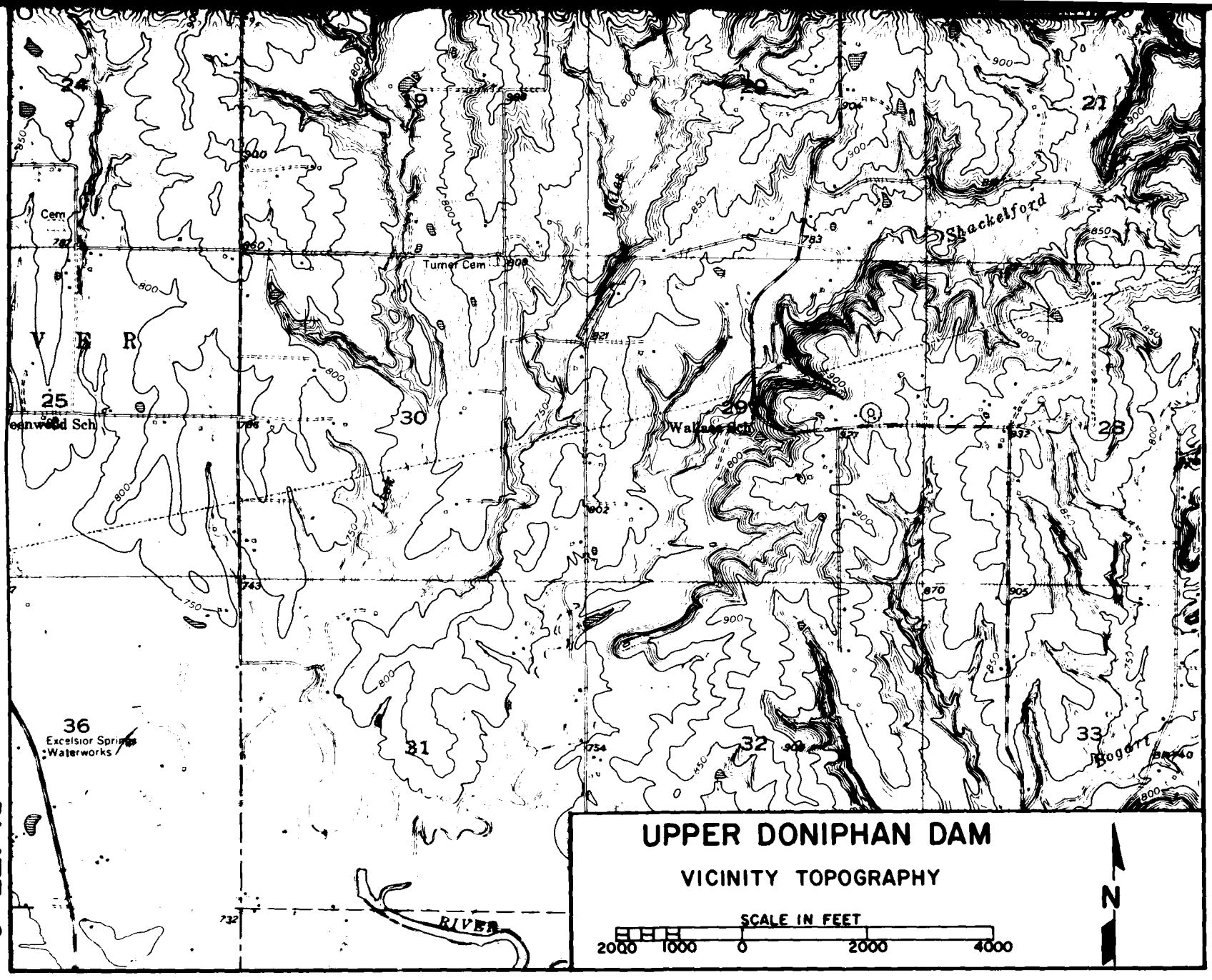

Cem
Turner Cem
Shackelford
Wallace Sch
Oakwood Sch
Excelsior Springs Waterworks
RIVER
24
19
20
21
25
30
29
28
31
32
33
36
UPPER DONIPHAN DAM
VICINITY TOPOGRAPHY
SCALE IN FEET
2000 1000 0 2000 4000
N

PLATE 2

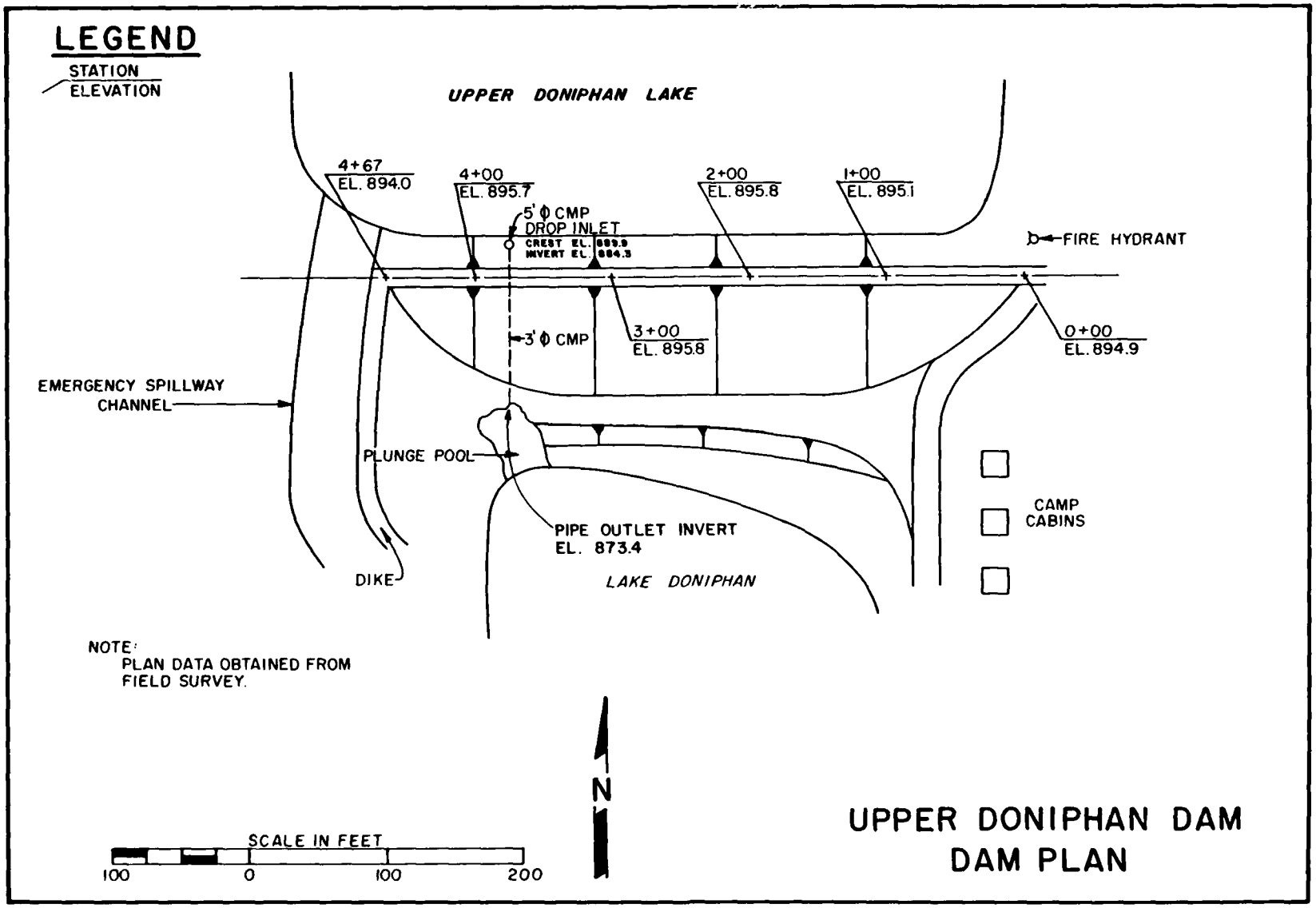
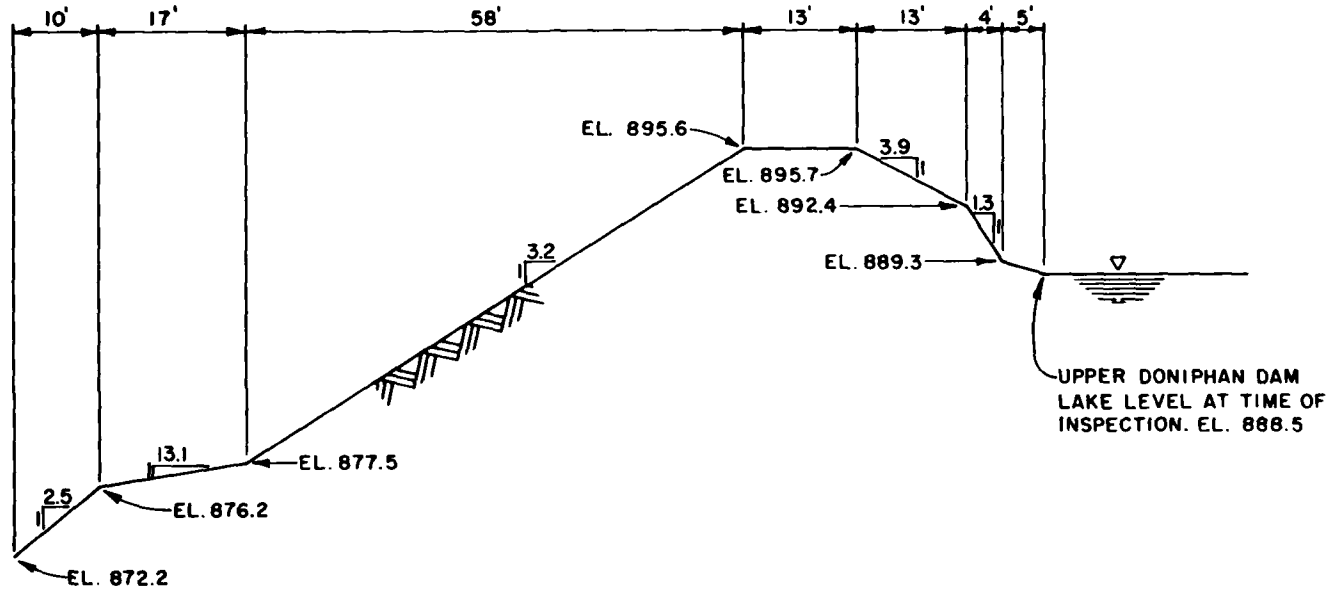

LEGEND
STATION
ELEVATION
UPPER DONIPHAN LAKE
4+67
EL. 894.0
4+00
EL. 895.7
2+00
EL. 895.8
1+00
EL. 895.1
5' ϕ CMP
DROP INLET
CREST EL. 899.9
INVERT EL. 884.3
FIRE HYDRANT
3' ϕ CMP
3+00
EL. 895.8
0+00
EL. 894.9
EMERGENCY SPILLWAY
CHANNEL
PLUNGE POOL
PIPE OUTLET INVERT
EL. 873.4
CAMP
CABINS
DIKE
LAKE DONIPHAN
NOTE:
PLAN DATA OBTAINED FROM
FIELD SURVEY.
SCALE IN FEET
100
0
100
200
N
UPPER DONIPHAN DAM
DAM PLAN

PLATE 3



NOTE:
CROSS SECTION TAKEN
NEAR STATION 3+20.

PLATE 4

UPPER DONIPHAN DAM
DAM CROSS SECTION

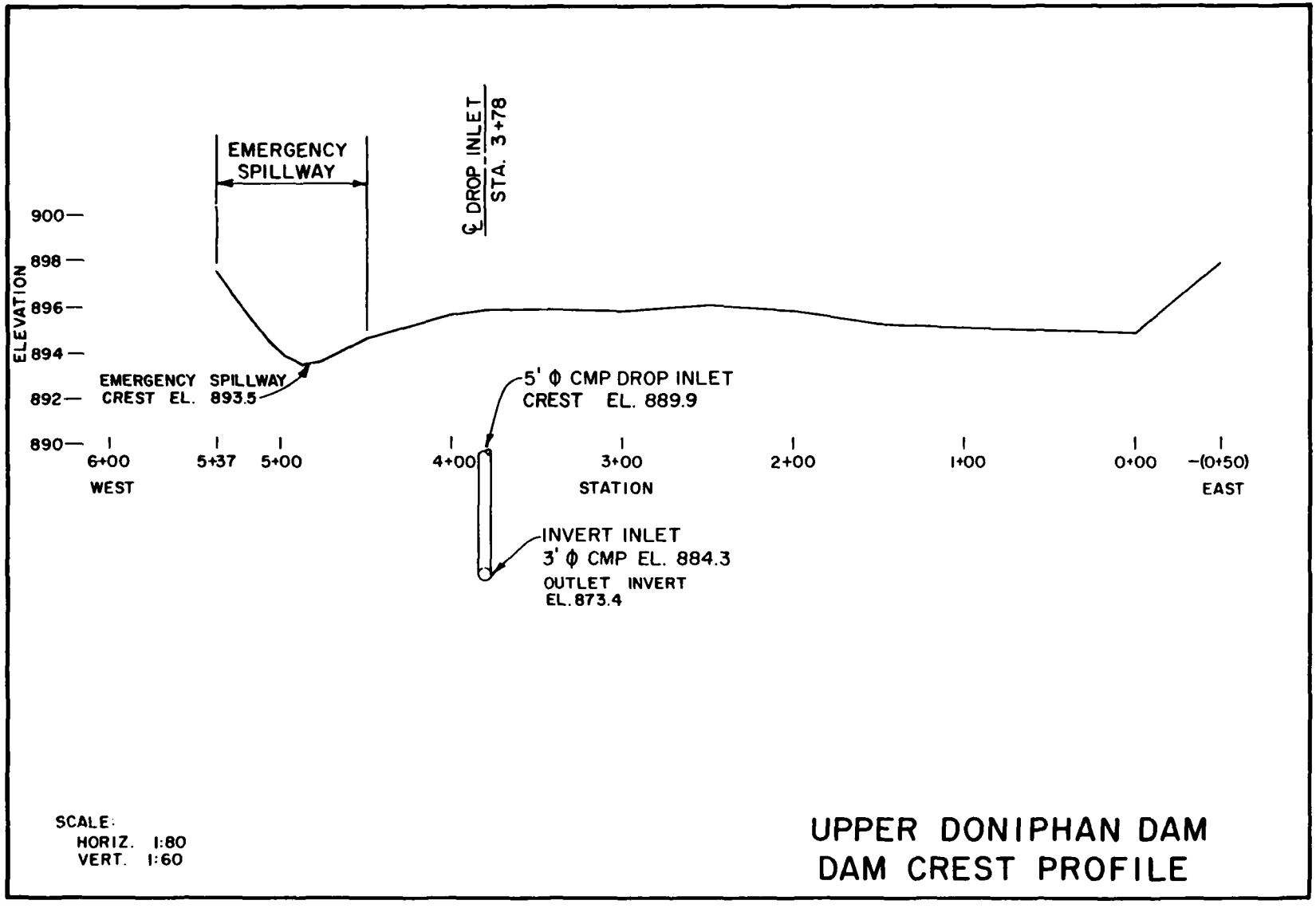
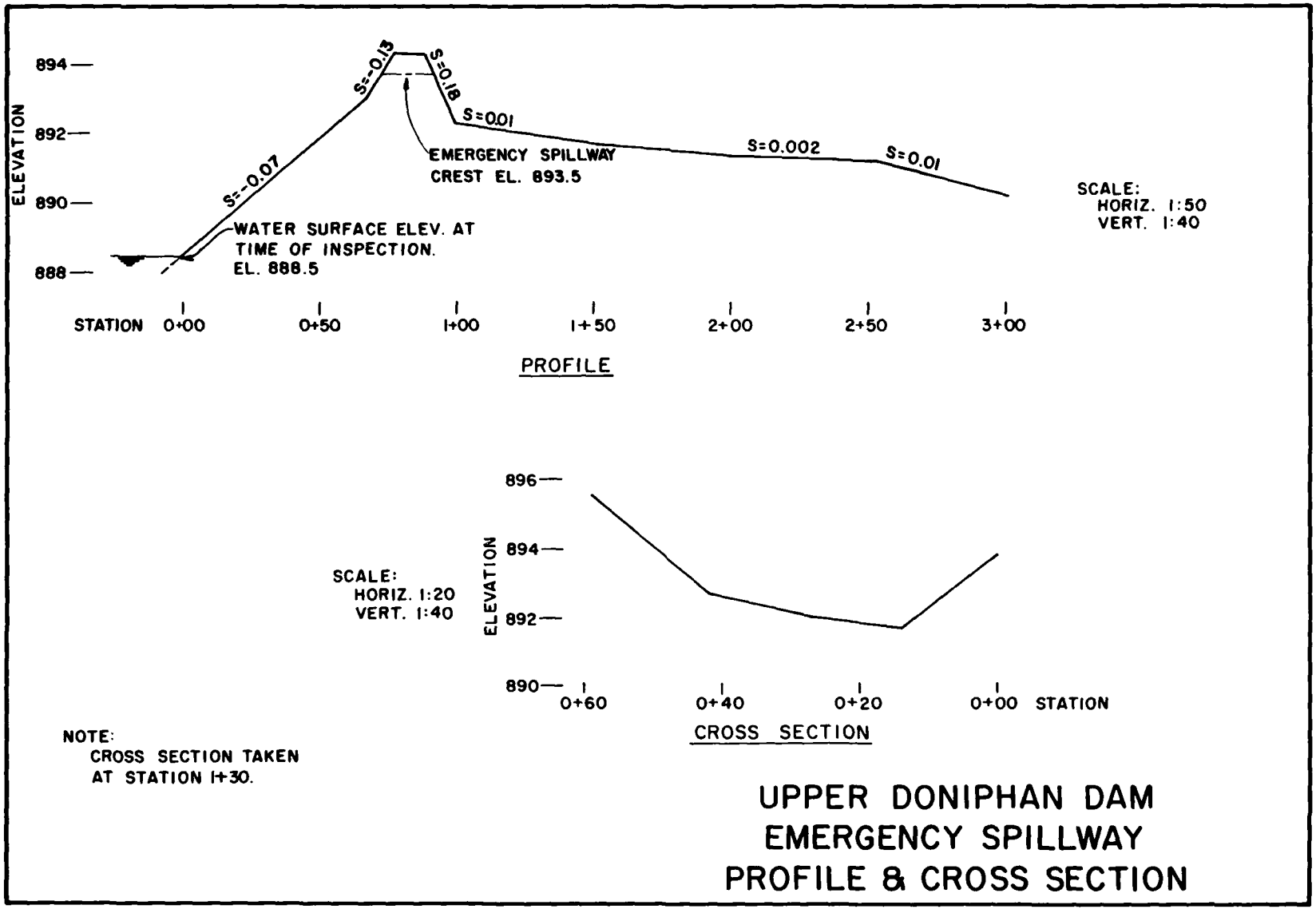


PLATE 5

SCALE:
HORIZ. 1:80
VERT. 1:60

UPPER DONIPHAN DAM
DAM CREST PROFILE

PLATE 6



UPPER DONIPHAN DAM
EMERGENCY SPILLWAY
PROFILE & CROSS SECTION

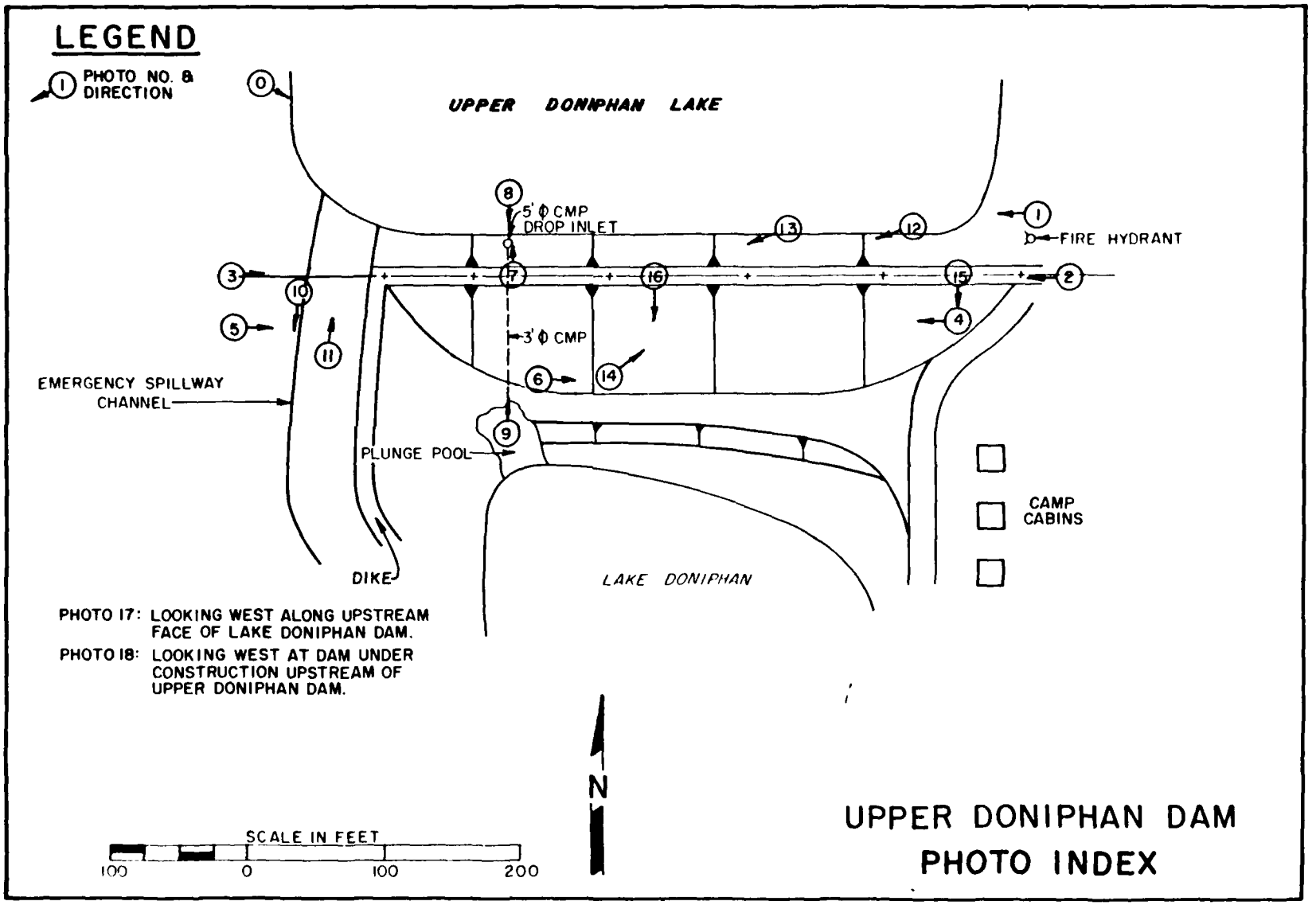

LEGEND
PHOTO NO. & DIRECTION
UPPER DONIPHAN LAKE
5' ϕ CMP DROP INLET
FIRE HYDRANT
3' ϕ CMP
EMERGENCY SPILLWAY CHANNEL
PLUNGE POOL
DIKE
LAKE DONIPHAN
CAMP CABINS
PHOTO 17: LOOKING WEST ALONG UPSTREAM FACE OF LAKE DONIPHAN DAM.
PHOTO 18: LOOKING WEST AT DAM UNDER CONSTRUCTION UPSTREAM OF UPPER DONIPHAN DAM.
SCALE IN FEET
100 0 100 200
N
UPPER DONIPHAN DAM
PHOTO INDEX

PLATE 7

PHOTO 1: UPSTREAM FACE OF DAM

PHOTO 2: CREST OF DAM LOOKING WEST

PHOTO 3: CREST OF DAM LOOKING EAST

PHOTO 4: DOWNSTREAM FACE OF DAM LOOKING WEST

PHOTO 5: DOWNSTREAM FACE OF DAM LOOKING EAST

PHOTO 6: BERM ON DOWNSTREAM SIDE OF DAM

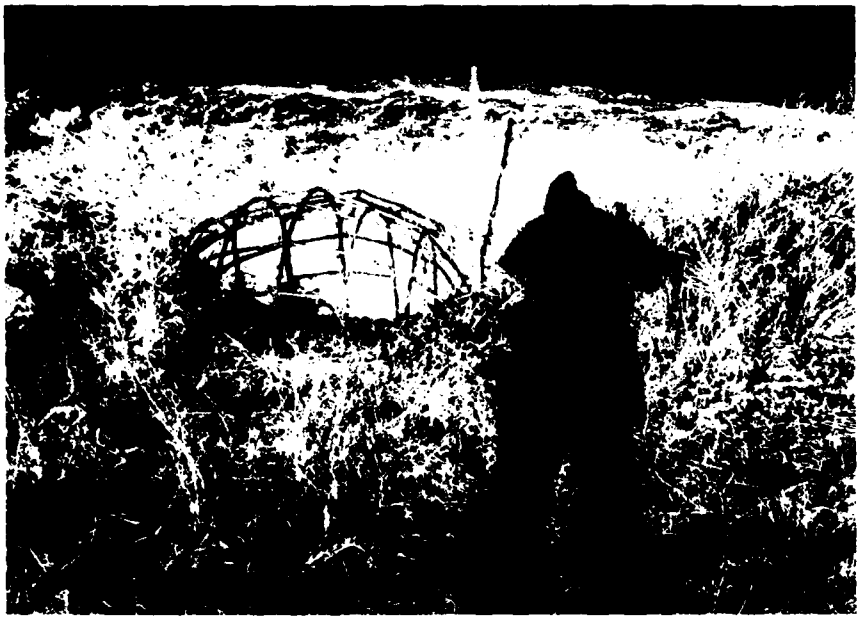


PHOTO 7: TRASH RACK OVER DROP INLET TO PRINCIPAL SPILLWAY

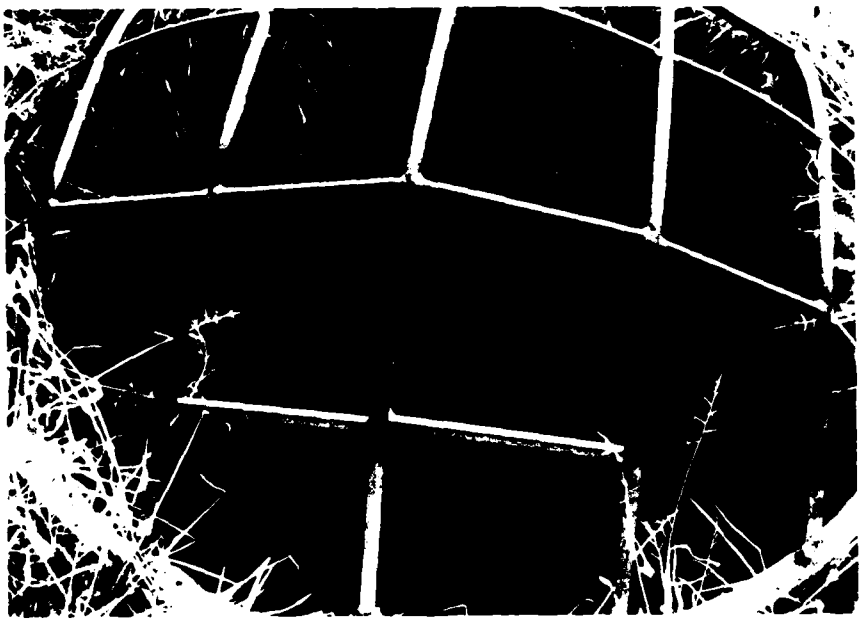


PHOTO 8: DROP INLET TO PRINCIPAL SPILLWAY

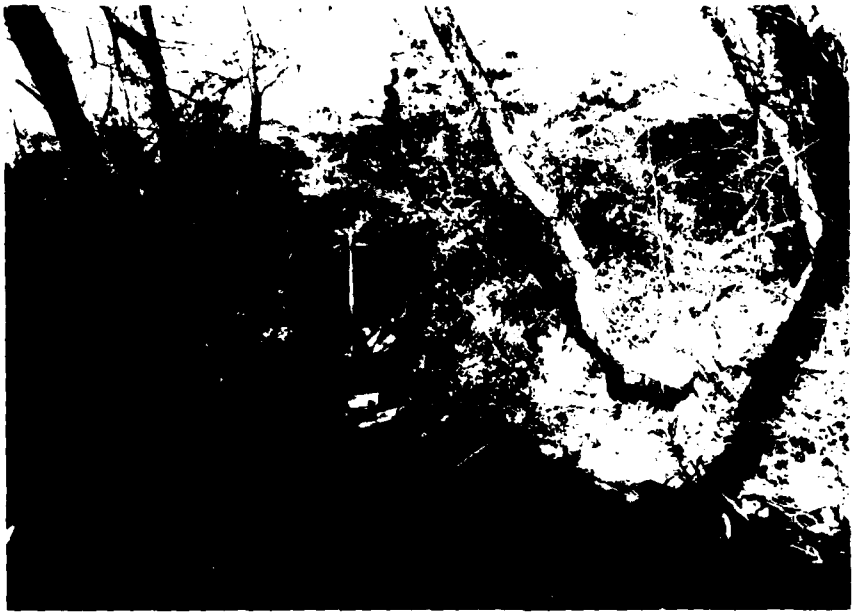


PHOTO 9: OUTLET END OF PRINCIPAL SPILLWAY PIPE

PHOTO 10: EMERGENCY SPILLWAY CHANNEL LOOKING DOWNSTREAM

PHOTO 11: EMERGENCY SPILLWAY CHANNEL LOOKING UPSTREAM

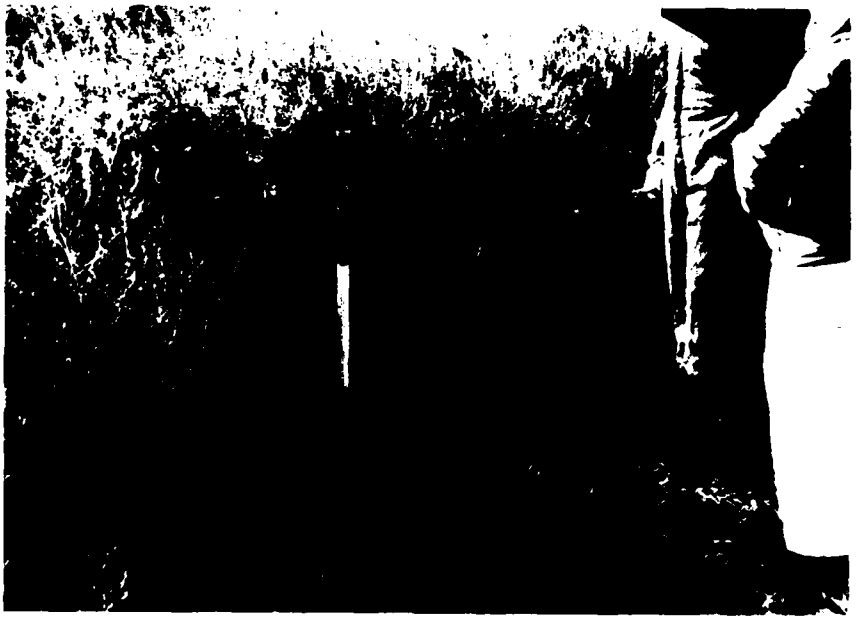


PHOTO 12: WAVE ACTION EROSION ON UPSTREAM FACE OF DAM

PHOTO 13: ANIMAL BURROWS ON UPSTREAM FACE OF DAM

PHOTO 14: ANIMAL BURROWS ON DOWNSTREAM BERM

PHOTO 15: CAMP CABINS DOWNSTREAM FROM DAM

PHOTO 16: LOWER LAKE VIEWED FROM UPPER DAM

PHOTO 17: LOWER LAKE DAM

PHOTO 18: NEW DAM IN WATERSHED UPSTREAM OF UPPER DONIPHAN

APPENDIX A

HYDROLOGIC AND HYDRAULIC ANALYSES

HYDROLOGIC AND HYDRAULIC ANALYSES

To determine the overtopping potential, flood routings were performed by applying the Probable Maximum Precipitation (PMP) synthetic unit hydrographs to develop the inflow hydrographs for Upper Doniphan Dam and one upstream dam. The inflow hydrographs were then routed through the reservoirs and spillways. The overtopping analysis was determined using the computer program HEC-1 (Dam Safety Version) (1).

The PMP was determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33" (HMR-33) (2). Reduction factors were not applied. The rainfall distribution for the 24-hour PMP storm was determined according to the procedures outlined in HMR-33 and EM 1110-2-1411 (3). The Kansas City, Missouri rainfall distribution (5 min. interval - 24 hours duration), as provided by the St. Louis District, Corp of Engineers, was used when the one percent probability flood was routed through the reservoirs and spillways.

The synthetic unit hydrographs for the watersheds were developed by the computer program using the Soil Conservation Service (SCS) method (1, 7). The parameters for the unit hydrograph are shown in Table 1. The formulas from which the lag time and time of concentrating were derived are noted in Table 1. The lag time was verified by the SCS curve number method (4).

The SCS curve number (CN) method was used in computing the infiltration losses for the rainfall-runoff relationship. The CN values used, and the result from the computer output, are shown in Table 2.

The storms were routed through the two reservoirs using the modified Puls method. The initial reservoir pool elevations for the routing of each storm was determined to be equivalent to the crest elevation of the principal spillways in accordance with antecedent storm conditions preceding the one percent probability and probable maximum storms as outlined by the U.S. Army Corps of Engineers, St. Louis District (5). The hydraulic capacity of the spillways and the storage capacities of the two reservoirs are defined by the elevation, surface area, storage, and discharge relationships shown in Table 3.

The rating curves for the spillways are shown in Table 4. The rating curve for the spillway of the upstream reservoir was calculated from nomographs for culverts with inlet control (6). The rating curve for the principal spillway for Upper Doniphan Dam is based on weir and pipe flow equations. Discharges through the emergency spillway at Upper Doniphan Dam were calculated using backwater analysis. The flow over the crest of both dams was determined using the non-level dam crest option ($L and $V cards) of the HEC-1 program. The program assumes critical flow over a broad-crested weir.

Where routings through the upstream reservoir resulted in overtopping of that structure, a breach analysis was performed using HEC-1. The breaching parameters are noted in Table 5.

The result of the routing analysis indicates that the spillways will pass a flood equivalent to 15 percent of the PMF without overtopping the dam.

A summary of the routing analysis for different ratios of the PMF is shown in Table 6.

The computer input data and a summary of the output data are presented at the back of this appendix.

TABLE 1

SYNTHETIC UNIT HYDROGRAPH

Parameters:	Upper Doniphan Dam**	Upstream Dam
Uncontrolled Drainage Area	102 acres	155 acres
Length of Watercourse (L)	0.38 miles	0.53 miles
Difference in Elevation (H)	110 feet	85 feet
Time of Concentration (T_c)	0.14 hours	0.22 hours
Lag Time (L_g)	0.08 hours	0.14 hours
Duration (D)	5 minutes	5 minutes

Unit Hydrograph Ordinates
Discharge (cfs)*

Time (Min.)	Upper Doniphan Dam	Upstream Dam
0	0	0
5	496	259
10	501	636
15	162	512
20	54	237
25	17	115
30	6	54
35	1	25
40	0	12
45	0	6
50	0	3

* From HEC-1 Computer Output
** Excludes Controlled Drainage Area Upstream

TABLE 1
(Continued)

FORMULAS USED:

$$T_c = (11.9L^3/H)^{0.385} \qquad (7)$$

$$L_g = 0.6\ T_c$$

$$D = 0.133\ T_c$$

TABLE 2

RAINFALL-RUNOFF VALUES

Selected Storm Event	Storm Duration (Hours)	Rainfall (Inches)	Runoff (Inches)	Loss (Inches)
Upper Doniphan Dam				
PMP	24	31.98	29.16	2.82
1% Probability	24	7.59	3.35	4.24
Upstream Dam				
PMP	24	31.98	29.49	2.49
1% Probability	24	7.59	3.68	3.91

Additional Data:

1) The soil association in this watershed is the Sharpsburg Association (from Ray County General Soils Map), hydrologic soil group B.
2) Land use:

	Upper Doniphan Dam	Upstream Dam
Urban Development - Low Density	1%	24%
Grassland	55%	55%
Cropland	15%	15%
Timberland	29%	6%

3) SCS Runoff Curve Number:

	Upper Doniphan Dam	Upstream Dam
PMF (AMC III)	80	82
1% Probability (AMC II)	63	66

TABLE 3

ELEVATION, SURFACE AREA, STORAGE, AND DISCHARGE RELATIONSHIPS

Elevation (feet-MSL)	Lake Surface Area (acres)	Lake Storage (acre-ft)	Spillway Discharge (cfs)
Upper Doniphan Dam			
*889.9	10.6	63	0
**893.5	12.3	104	154
***894.0	12.5	110	166
Upstream Dam			
*914.9	2.7	31	0
***917.2	3.1	37	3

*Principal spillway crest elevation
**Emergency spillway crest elevation
***Top of dam elevation

The relationships in Table 3 were developed from the Excelsior Springs, Missouri, 7.5 minute quadrangle map and the field measurements.

TABLE 4

SPILLWAY RATING CURVES

Reservoir Elevation (ft-m.s.l)	Primary Spillway Discharge (cfs)	Emergency Spillway Discharge (cfs)	Total Spillway Discharge (cfs)
Upper Doniphan Dam			
*889.9	0	0	0
891.0	63	0	63
**893.5	154	0	154
***894.0	156	10	166
895.0	160	155	315
****897.2	170	870	1,040

TABLE 4
SPILLWAY RATING CURVES
(Continued)

Upstream Dam

*914.2	0	-	0
915.2	2	-	2
***917.2	3	-	3
****918.8	4	-	4

*Principal Spillway Crest
**Emergency Spillway Crest
***Top of Dam
****Probable Maximum Flood Pool Level

METHODS USED:

Upper Doniphan Dam:

The principal spillway (5-foot diameter drop inlet) discharge rates were computed using weir and pipe flow equations. The weir equation is:

$$Q = CLH^{1.5}$$

where:

Q = flow in cfs
C = coefficient of discharge = 3.5
L = weir length = πD = 15.7 ft.
H = head in feet = difference between water surface level and drop inlet crest.

The pipe flow equation is:

$$Q = \frac{A(2gH)^{0.5}}{(\Sigma K)^{0.5}}$$

TABLE 4
SPILLWAY RATING CURVES
(Continued)

where:

Q = flow in cfs
A = cross sectional area = 7.07 sq. ft.
g = acceleration due to gravity = 32.2 ft/sec^2
H = available head
ΣK = sum of head losses = 2.5

The emergency spillway discharges were computed by backwater using computer program HEC-2(8).

Upstream Dam:

Spillway discharge rates were determined using nomographs for a pipe culvert with inlet control (5).

TABLE 5

BREACHING PARAMETERS

	Upstream Dam
Bottom Width of Breach (BRWID)	10 feet
Side Slope of Breach (z) (In feet horizontal to 1.0 feet vertical)	0.5 feet
Elevation of Breach Bottom at Maximum Size of Breach (ELBM)	910.0 ft. m.s.l.
Time for Breach to Develop to Maximum Size (TFAIL)	1.0 hour
Elevation of Water Surface Which Will Cause Dam to Fail (FAILEL)	917.2 ft. m.s.l.

TABLE 6

RESULTS OF FLOOD ROUTINGS

Ratio of PMF	Peak Inflow (CFS)	Peak Lake Elevation (ft.-MSL)	Total Storage (AC.-FT.)	Peak Outflow (CFS)	Depth (ft.) Over Top of Dam	Duration of Over-Topping (hrs)
-	0	*889.9	63	0	-	-
0.15	517	893.3	102	153	0	-
0.50	2,040	896.3	140	1,800	2.3	4.9
1.00	5,040	897.2	153	4,560	3.2	6.9

*Principal Spillway Crest Elevation

BIBLIOGRAPHY

(1) U.S. Army Corps of Engineers, Hydrologic Engineering Center, Flood Hydrograph Package (HEC-1), Dam Safety Version, July 1978, Modification April 1980, Davis, California.

(2) HMR 33, Seasonal Variations of Probable Maximum Precipitation, East of the 105th Meridian for Areas 10 to 1000 Square Miles and Durations from 6 to 48 Hours, U.S. Department of Commerce, NOAA, National Weather Service, 1956.

(3) EM-1110-2-1411, Standard Project Flood Determinations, U.S. Army Corps of Engineers, 26 March 1952.

(4) U.S. Department of Agriculture, Soil Conservation Service, National Engineering Handbook, Section 4, Hydrology, August 1972.

(5) U.S. Army Corps of Engineers, St. Louis District, Hydrologic/ Hydraulic Standards, Phase I Safety Inspection of Non-Federal Dams, 22 August 1980.

(6) U.S. Department of Commerce, Bureau of Public Roads, Hydraulic Engineering Circular No. 5, Hydraulic Charts for the Selection of Highway Culverts, December 1965.

(7) U.S. Department of the Interior, Bureau of Reclamation, Design of Small Dams, Washington, D.C., 1974.

(8) U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Davis, California, November 1976.

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B L A C K   &   V E A T C H                                              PROJECT 5472:       DATE 07 JAN 81   PAGE
========================================================================================================================
FLOOD HYDROGRAPH PACKAGE - HEC-1                                        PROGRAM HEC1/DB-1V  TIME 13:47:02   PAGE

********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  21 APR 80
********************************
A1        MISSOURI DAM INSPECTIONS
A2        UPPER DONIPHAN DAM
A3        PMF AND RATIOS
B     288       0       5       0       0       0       0       0       0       0
B1      5
J       1       9       1
J1    0.1    0.15    0.20    0.25    0.30    0.35    0.40    0.5     1.0
K          DSGCAP
K1        CALCULATE INFLOW HYDROGRAPH TO GOLF COURSE LAKE
M       1     0.24                        1.
P     24.4    111.    120.    130.
T                                                          -1-.52.
W2    0.14
X               1.
K       1   USGCAP                                         1
K1        ROUTE HYDROGRAPHS THROUGH GOLF COURSE DAM
Y                             1         1
Y1      1                                           -914.9          -1
Y4914.2 915.2    916.2   917.2   918.2   920.2   925.2
Y5      1.0      2.0     3.0     4.      5.      6.
Y6      1.5      2.0     3.0     3.6
$E905.  910.     912.    915.    920.
$S914.5
$D917.0
$L0.    50.      100.    150.    420.    420.
$V917.0  917.5    917.5   917.6   917.7   930.
$$110.  0.0      916.    1.      914.9   917.2
K          USCON                                           1
K1        CALCULATE INFLOW FROM UNCONTROLLED AREA OF UPPER DONIPHAN DAM
M       1     25.17                       1.
P     24.4    111.    120.    130.
T                                                          -1-.50.
W2    0.05
X               1.
K       2   DSHED                                          1
K1        COMBINE HYDROGRAPHS
K       1   DSCAP                                          1
K1        ROUTE HYDROGRAPHS THROUGH UPPER DONIPHAN DAM
Y                             1         1
Y1      1                                           -889.9          -1
Y4889.5 890.5    891.    892.    893.5   894.    895.    896.    898.    899.
Y5      22.      67.     147.    154.    166.    395.    544.    1170.   1420.
Y6      13.7     15.7    24.5
$E880.  890.     970.    990.
$S889.5
$D894.0
$L0.    17.      52.     227.    293.    447.    447.
$V893.5  894.0    895.    895.5   895.0   896.    900.
K      99
A
```

UPPER DONIPHAN DAM
PMF & RATIOS
PASS 15%

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	USHEAD
ROUTE HYDROGRAPH TO	LSDAM
RUNOFF HYDROGRAPH AT	UNCON
COMBINE 2 HYDROGRAPHS AT	DSHED
ROUTE HYDROGRAPH TO	DSDAM
END OF NETWORK	

BLACK & VEATCH

HEC-1 HYDROGRAPH PACKAGE - HEC-1

****
HEC-1 HYDROGRAPH PACKAGE (HEC-1)
FLOOD HYDROGRAPH PACKAGE (HEC-1)
JULY 1978 SEVEN VERSION
LAST MODIFICATION 01 APR 80
****

*ISOHYETAL DAM INSPECTIONS
*GOLF COURSE DAM
*SCS RUNOFF RATIOS

JOB SPECIFICATION

NO	NMIN	IDAY	IHR	IMIN	METRIC	IPLT	IPRT	NSTAN
25	5	2	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1

RTIOS= .10 .15 .20 .25 .30 .35 .40 .50 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

CALCULATE INFLOW HYDROGRAPH TO GOLF COURSE LAKE

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
USHEAD	0	0	0	0	0	0	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.24	.00	.24	1.00	.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R24	R48	R72	R96
.00	24.00	100.00	100.00	100.00	.00	.00	.00

LOSS DATA

LOSS	STRTL	CNSTL	ALSMX	RTIOL	ERAIN	STRKS	RTIOK	STKTL	CNSTL	ALSMX	RTIMP
2	0.0	0.0	0.0	1.00	.00	.00	1.00	-1.00	-82.00	0.0	.00

STRKS = 0.000 RTIOKS = -1.00 PERCENT CN = 82.00

UNIT HYDROGRAPH DATA

TC= .50 LAG= .34

RECESSION DATA

STRTQ= .00 QRCSN= .00 RTIOR= 1.00

TIME INCREMENT FOR LAGGE--(DNG IS GT LAG/2)

UNIT HYDROGRAPH 10 END OF PERIOD ORDINATES, TC= .50 HOURS, LAG= .34 VOL= 1.00

250.	474.	91.	39.	11.	54.	25.	12.	6.	3.

[illegible] FOR [illegible] IS CFS/CFS

PEAK HYDROGRAPH TO END OF PERIOD ORDINATES, TCP= .00 HOURS, LAG= .1= VOLS 1.0=
254. 224. 512. 737. 115. 54. 25. 12. 6. [illegible]

BLACK & VEATCH PROJECT 5457: DATE 07 JAN 81 PAGE [illegible]

[illegible] HYDROGRAPH PACKAGE - HEC-1 PROBLEM HC1/SC-1V TIME 17:47:17 CAPT

						END-OF-PERIOD FLOW						
	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
	1.01	.05	1	.01	.00	.01	0.	1.01	12.05	145	.21	.19	.02	143.
	1.01	.10	2	.01	.00	.01	0.	1.01	12.10	146	.21	.19	.02	427.
	1.01	.15	3	.01	.00	.01	0.	1.01	12.15	147	.21	.19	.02	854.
	1.01	.20	4	.01	.00	.01	0.	1.01	12.20	148	.21	.19	.02	1281.
	1.01	.25	5	.01	.00	.01	0.	1.01	12.25	149	.21	.19	.01	1708.
	1.01	.30	6	.01	.00	.01	0.	1.01	12.30	150	.21	.19	.01	2135.
	1.01	.35	7	.01	.00	.01	0.	1.01	12.35	151	.21	.19	.01	2562.
	1.01	.40	8	.01	.00	.01	0.	1.01	12.40	152	.21	.19	.01	2989.
	1.01	.45	9	.01	.00	.01	0.	1.01	12.45	153	.21	.20	.01	3416.
	1.01	.50	10	.01	.00	.01	0.	1.01	12.50	154	.21	.20	.01	3843.
	1.01	.55	11	.01	.00	.01	0.	1.01	12.55	155	.21	.20	.01	4270.
	1.01	1.00	12	.01	.00	.01	0.	1.01	13.00	156	.21	.20	.01	4697.
	1.01	1.05	13	.01	.00	.01	0.	1.01	13.05	157	.22	.21	.01	5124.
	1.01	1.10	14	.01	.00	.01	0.	1.01	13.10	158	.22	.21	.01	5551.
	1.01	1.15	15	.01	.00	.01	0.	1.01	13.15	159	.22	.21	.01	5978.
	1.01	1.20	16	.01	.00	.01	0.	1.01	13.20	160	.22	.21	.01	6405.
	1.01	1.25	17	.01	.00	.01	0.	1.01	13.25	161	.22	.21	.01	6832.
	1.01	1.30	18	.01	.00	.01	0.	1.01	13.30	162	.22	.21	.01	441.
	1.01	1.35	19	.01	.00	.01	0.	1.01	13.35	163	.22	.21	.01	441.
	1.01	1.40	20	.01	.00	.01	0.	1.01	13.40	164	.22	.21	.01	441.
	1.01	1.45	21	.01	.00	.01	0.	1.01	13.45	165	.22	.21	.01	441.
	1.01	1.50	22	.01	.00	.01	0.	1.01	13.50	166	.22	.21	.01	441.
	1.01	1.55	23	.01	.00	.01	0.	1.01	13.55	167	.22	.21	.01	441.
	1.01	2.00	24	.01	.00	.01	0.	1.01	14.00	168	.22	.21	.01	441.
	1.01	2.05	25	.01	.00	.01	0.	1.01	14.05	169	.31	.30	.01	441.
	1.01	2.10	26	.01	.00	.01	0.	1.01	14.10	170	.31	.30	.01	441.
	1.01	2.15	27	.01	.00	.01	0.	1.01	14.15	171	.31	.30	.01	441.
	1.01	2.20	28	.01	.00	.01	0.	1.01	14.20	172	.31	.30	.01	441.
	1.01	2.25	29	.01	.00	.01	0.	1.01	14.25	173	.31	.30	.01	441.
	1.01	2.30	30	.01	.00	.01	0.	1.01	14.30	174	.31	.30	.01	441.
	1.01	2.35	31	.01	.00	.01	0.	1.01	14.35	175	.31	.30	.01	441.
	1.01	2.40	32	.01	.00	.01	0.	1.01	14.40	176	.31	.30	.01	441.
	1.01	2.45	33	.01	.00	.01	0.	1.01	14.45	177	.31	.30	.01	441.
	1.01	2.50	34	.01	.00	.01	0.	1.01	14.50	178	.31	.30	.01	441.
	1.01	2.55	35	.01	.00	.01	0.	1.01	14.55	179	.31	.30	.01	441.
	1.01	3.00	36	.01	.00	.01	1.	1.01	15.00	180	.31	.31	.01	441.
	1.01	3.05	37	.01	.00	.01	1.	1.01	15.05	181	.31	.29	.01	441.
	1.01	3.10	38	.01	.00	.01	1.	1.01	15.10	182	.31	.29	.01	441.
	1.01	3.15	39	.01	.00	.01	1.	1.01	15.15	183	.31	.29	.01	441.
	1.01	3.20	40	.01	.00	.01	2.	1.01	15.20	184	.31	.29	.01	441.
	1.01	3.25	41	.01	.00	.01	2.	1.01	15.25	185	.31	.29	.01	441.
	1.01	3.30	42	.01	.00	.01	2.	1.01	15.30	186	1.01	1.00	.01	1441.
	1.01	3.35	43	.01	.00	.01	2.	1.01	15.35	187	2.06	2.02	.04	2882.
	1.01	3.40	44	.01	.00	.01	3.	1.01	15.40	188	1.04	1.03	.01	2882.
	1.01	3.45	45	.01	.00	.01	3.	1.01	15.45	189	.34	.33	.01	2882.
	1.01	3.50	46	.01	.00	.01	3.	1.01	15.50	190	.32	.31	.01	2882.
	1.01	3.55	47	.01	.00	.01	3.	1.01	15.55	191	.32	.31	.01	2882.
	1.01	4.00	48	.01	.00	.01	4.	1.01	16.00	192	.32	.31	.01	2882.
	1.01	4.05	49	.01	.00	.01	4.	1.01	16.05	193	.32	.31	.01	2882.
	1.01	4.10	50	.01	.00	.01	4.	1.01	16.10	194	.32	.31	.01	2882.
	1.01	4.15	51	.01	.00	.01	5.	1.01	16.15	195	.32	.31	.01	2882.
	1.01	4.20	52	.01	.00	.01	5.	1.01	16.20	196	.32	.31	.01	2882.

FLOOD HYDROGRAPH PACKAGE - HEC-1 PROGRAM H61/02-1V TIME 17:47:07 CAPL

1.01	9.10	111.	.06	.05	.01	98.	1.01	21.10	254	.02	.02	.00	254.
1.01	9.15	111	.06	.05	.01	98.	1.01	21.15	255	.02	.02	.00	255.
1.01	9.20	112	.06	.05	.01	99.	1.01	21.20	256	.02	.02	.00	256.
1.01	9.25	113	.06	.05	.01	99.	1.01	21.25	257	.02	.02	.00	257.
1.01	9.30	114	.06	.05	.01	100.	1.01	21.30	258	.02	.02	.00	258.
1.01	9.35	115	.06	.05	.01	100.	1.01	21.35	259	.02	.02	.00	259.
1.01	9.40	116	.06	.05	.01	101.	1.01	21.40	260	.02	.02	.00	260.
1.01	9.45	117	.06	.05	.01	101.	1.01	21.45	261	.02	.02	.00	261.
1.01	9.50	118	.06	.05	.01	102.	1.01	21.50	262	.02	.02	.00	262.
1.01	9.55	119	.06	.05	.01	102.	1.01	21.55	263	.02	.02	.00	263.
1.01	10.00	120	.06	.05	.01	103.	1.01	22.00	264	.02	.02	.00	264.
1.01	10.05	121	.06	.05	.01	103.	1.01	22.05	265	.02	.02	.00	265.
1.01	10.10	122	.06	.05	.01	104.	1.01	22.10	266	.02	.02	.00	266.
1.01	10.15	123	.06	.05	.01	104.	1.01	22.15	267	.02	.02	.00	267.
1.01	10.20	124	.06	.05	.01	104.	1.01	22.20	268	.02	.02	.00	268.
1.01	10.25	125	.06	.05	.01	105.	1.01	22.25	269	.02	.02	.00	269.
1.01	10.30	126	.06	.05	.01	105.	1.01	22.30	270	.02	.02	.00	270.
1.01	10.35	127	.06	.05	.01	105.	1.01	22.35	271	.02	.02	.00	271.
1.01	10.40	128	.06	.05	.01	106.	1.01	22.40	272	.02	.02	.00	272.
1.01	10.45	129	.06	.05	.01	106.	1.01	22.45	273	.02	.02	.00	273.
1.01	10.50	130	.06	.05	.01	106.	1.01	22.50	274	.02	.02	.00	274.
1.01	10.55	131	.06	.05	.01	106.	1.01	22.55	275	.02	.02	.00	275.
1.01	11.00	132	.06	.05	.01	107.	1.01	23.00	276	.02	.02	.00	276.
1.01	11.05	133	.06	.05	.01	107.	1.01	23.05	277	.02	.02	.00	277.
1.01	11.10	134	.06	.05	.01	107.	1.01	23.10	278	.02	.02	.00	278.
1.01	11.15	135	.06	.05	.01	108.	1.01	23.15	279	.02	.02	.00	279.
1.01	11.20	136	.06	.05	.01	108.	1.01	23.20	280	.02	.02	.00	280.
1.01	11.25	137	.06	.05	.01	108.	1.01	23.25	281	.02	.02	.00	281.
1.01	11.30	138	.06	.05	.01	109.	1.01	23.30	282	.02	.02	.00	282.
1.01	11.35	139	.06	.05	.01	109.	1.01	23.35	283	.02	.02	.00	283.
1.01	11.40	140	.06	.05	.01	109.	1.01	23.40	284	.02	.02	.00	284.
1.01	11.45	141	.06	.05	.01	109.	1.01	23.45	285	.02	.02	.00	285.
1.01	11.50	142	.06	.05	.01	109.	1.01	23.50	286	.02	.02	.00	286.
1.01	11.55	143	.06	.05	.01	109.	1.01	23.55	287	.02	.02	.00	287.
1.01	12.00	144	.06	.05	.01	110.	1.02	.00	288	.02	.02	.00	288.
								SUM	71.91	20.49	2.49		54213.
									(817.3)(749.3)(63.3)(1549.3)				

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2953.	625.	190.	190.	54690.
CMS	95.	18.	5.	5.	1549.
INCHES		24.18	25.44	25.44	25.44
CM		613.73	747.60	747.60	747.60
AC-FT		309.	377.	377.	377.
THOUS CU M		381.	465.	465.	465.

HYDROGRAPH AT STAUSHEAD FOR PLAN 1, RTIO 1

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

HEC-1 HYDROGRAPH PACKAGE - HEC-1 PROGRAM H21/32-1V TIME 13:47:57 DATE

109.	105.	109.	113.	143.	227.	296.	426.	442.	451.
356.	356.	360.	362.	363.	364.	375.	401.	422.	452.
479.	449.	442.	444.	445.	446.	446.	447.	463.	502.
536.	536.	556.	560.	562.	567.	604.	606.	605.	606.
646.	630.	646.	660.	857.	1206.	2224.	2997.	2659.	1946.
1446.	1042.	859.	747.	716.	672.	549.	541.	537.	536.
535.	535.	535.	535.	519.	486.	449.	434.	427.	424.
420.	420.	421.	421.	421.	421.	368.	237.	191.	87.
39.	39.	39.	39.	39.	39.	38.	38.	39.	39.
39.	39.	39.	39.	39.	39.	39.	39.	39.	39.
39.	39.	39.	39.	39.	39.	39.	39.	39.	39.
39.	39.	39.	39.	39.	39.	38.	38.	38.	38.
38.	38.	38.	38.	38.	38.	38.	38.	38.	38.
38.	38.	38.	38.	38.	38.	38.	38.	38.	38.
38.	38.	38.	38.	38.	38.	38.	38.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2995.	673.	190.	190.	54690.
CMS	85.	19.	5.	5.	1549.
INCHES		24.19	26.44	26.44	26.44
MM		614.70	742.60	742.60	742.60
AC-FT		399.	377.	377.	377.
THOUS CU M		251.	465.	465.	465.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE HYDROGRAPHS THROUGH GOLF COURSE DAM

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
USDAM	1	0	0	0	0	1	0	0

ROUTING DATA

MSKK	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
.00	.000	.00	1	1	0	0	0

NSTPS	NSTPL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	.000	.000	.000	-915.	-1

STAGE	914.00	915.20	916.20	917.20	918.20	920.20	925.20
FLOW	.00	1.50	2.60	3.20	4.00	5.00	6.00

SURFACE AREA	0.	1.	2.	3.	4.
CAPACITY	0.	7.	19.	40.	47.
ELEVATION	895.	900.	910.	919.	920.

CAPL SPILW COGW EXPW EEEVL COOL CAREA EXPL

```
     SURFACE AREA=         0.          2.          6.          9.         12.
        CAPACITY=         0.          7.         19.         40.         47.
       ELEVATION=       895.        900.        910.        918.        920.

                             CREL   SPWID   COQW   EXPW   ELEVL   COQL   CAREA   EXPL
                            914.9      .0     .0     .0      .0     .0      .0     .0



B L A C K   &   V E A T C H                                                          PROJECT 94572       DATE 07 JAN 81   PAGE  1
=====================================================================================================================================
FLOOD HYDROGRAPH PACKAGE - HEC-1                                                     PROGRAM H21/02-1V  TIME 13:47:03   CALL

                                                  DAM DATA
                                          TOPEL    COQD    EXPD   DAMWID
                                          917.2      .0      .0       0.

      CREST LENGTH         0.        55.       160.       180.       420.       420.
      AT OR BELOW
      ELEVATION        917.2      917.2      917.5      917.6      917.7      930.0

                                               DAM BREACH DATA
                                     BRWID        Z    ELBM    TFAIL     WSEL   FAILEL
                                       10.      .50  910.00     1.00   914.90   917.20

                                         STATION  USDAM, PLAN 1, RATIO 1

BEGIN DAM FAILURE AT 93.42 HOURS

                                           END-OF-PERIOD HYDROGRAPH ORDINATES

                                                   OUTFLOW
                1.          1.          1.          1.          1.          1.          1.          1.          1.          1.
                1.          1.          1.          1.          1.          1.          1.          1.          1.          1.
                1.          1.          1.          1.          1.          1.          1.          1.          1.          1.
                1.          1.          1.          1.          1.          1.          1.          1.          1.          1.
                1.          1.          1.          1.          1.          1.          1.          1.          1.          1.
                1.          1.          1.          1.          1.          1.          1.          1.          1.          1.
                1.          1.          1.          1.          1.          1.          1.          1.          1.          1.
                1.          1.          1.          1.          1.          1.          1.          1.          1.          1.
                1.          1.          1.          1.          1.          1.          1.          1.          1.          1.
                1.          1.          1.          1.          1.          1.          1.          1.          1.          1.
                1.          2.          2.          2.          2.          2.          2.          2.          2.          2.
                2.          2.          2.          2.          2.          2.          2.          2.          2.          2.
                2.          2.          2.          2.          2.          2.          2.          2.          2.          2.
                2.          2.          2.          2.          2.          2.          2.          2.          2.          2.
                2.          2.          2.          2.          2.          3.          3.          3.          3.          3.
                3.          3.          3.          3.          3.          3.          3.          3.          3.          3.
                4.         17.         26.         46.         65.         96.        135.        178.        215.        255.
              265.        307.        321.        250.        200.        166.        140.        122.        104.         97.
               69.         82.         76.         74.         74.         83.         99.        133.        106.        103.
              160.        157.        151.        134.        115.        107.         95.         85.         81.         76.
               77.         69.         66.         64.         62.         60.         57.         55.         53.         51.
               53.         46.         43.         47.         46.         45.         44.         42.         39.         34.
               30.         27.         24.         21.         19.         17.         16.         14.         13.         12.
               11.         10.         10.          9.          9.          8.          8.          7.          7.          7.
                7.          6.          6.          6.          6.          6.          5.          5.          5.          5.
                5.          5.          5.          5.          5.          5.          4.          4.          4.          4.
                4.          4.          4.          4.          4.          4.          4.          4.          4.          4.
                4.          4.          4.          4.          4.          4.          4.          4.          4.          4.
                4.          4.          4.          4.          4.          4.          4.          4.

                                                   STORAGE
               31.         31.         31.         31.         31.         31.         31.         31.         31.         31.
               31.         31.         31.         31.         31.         31.         31.         31.         31.         31.
               31.         31.         31.         31.         31.         31.         31.         31.         31.         31.
               31.         31.         30.         30.         30.         30.         30.         30.         30.         30.
```

HEC-1 FLOOD HYDROGRAPH PACKAGE - HEC-1 PROGRAM [illegible] TIME [illegible]

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SUB-AREA RUNOFF COMPUTATION

CALCULATE INFLOW FROM UNCONTROLLED AREA OF UPPER DONIPHAN DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
UNION	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.16	.00	.16	1.00	.000	0	0	0

FREEZE DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
.00	24.00	101.00	120.00	130.00	.00	.00	.00

LOSS DATA

LRUPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOR	STRTL	CNSTL	ALSMA	RTIMP
1	.00	.00	1.00	.00	.00	1.00	-1.00	-69.00	.00	.00

CURVE NO = --.-- WETNESS = -1.00 EFFECT CN = 80.00

UNIT HYDROGRAPH DATA

TC= .00 LAG= .00

PRECIPITATION DATA

STRTG= .00 CRCSN= .00 RTIOR= 1.00

TIME INCREMENT TOO LARGE--(SNQ IS GT LAG/2)

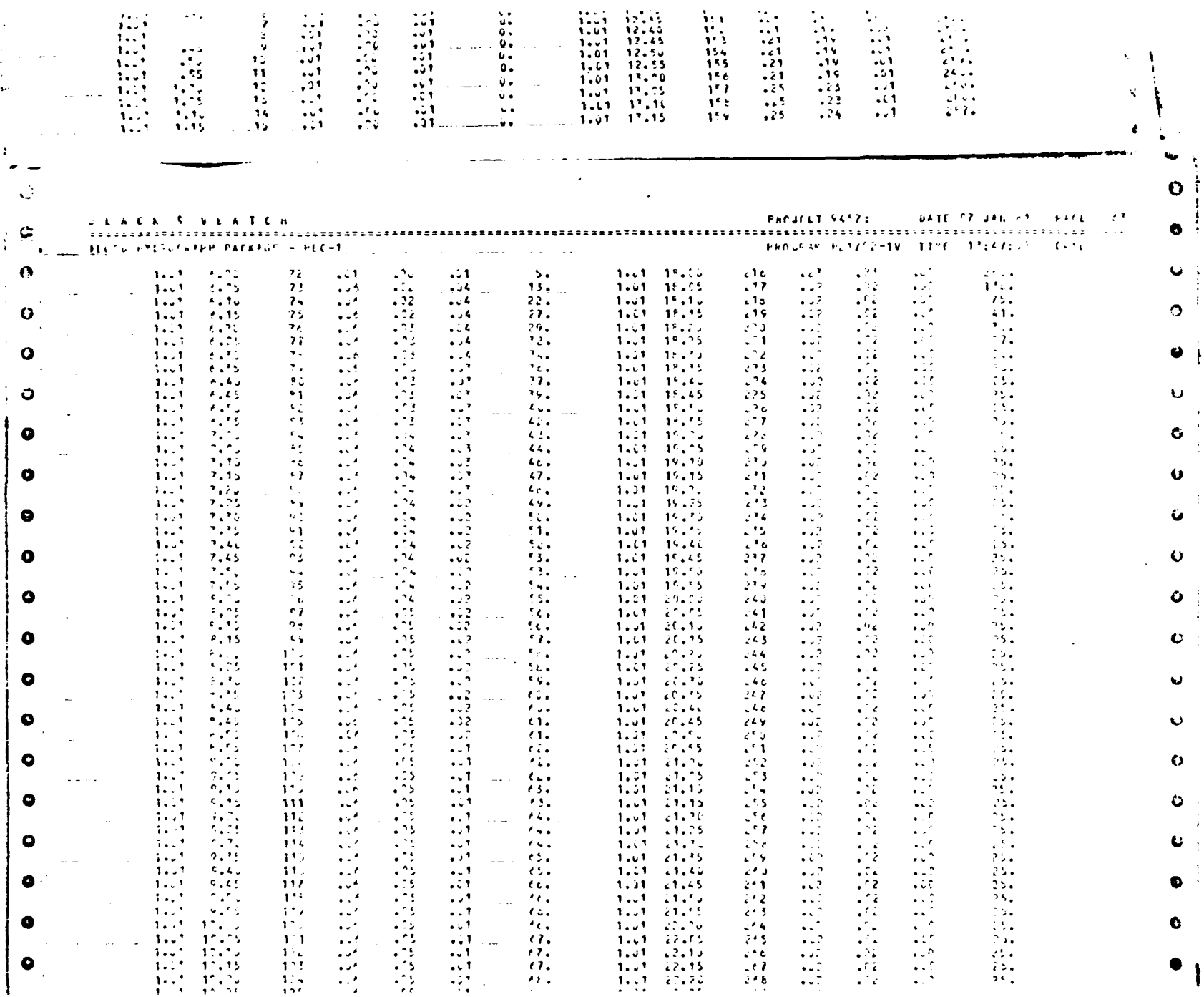
UNIT HYDROGRAPH 7 END OF PERIOD ORDINATES, TC= .00 HOURS, LAG= .00 VOL= 1.00

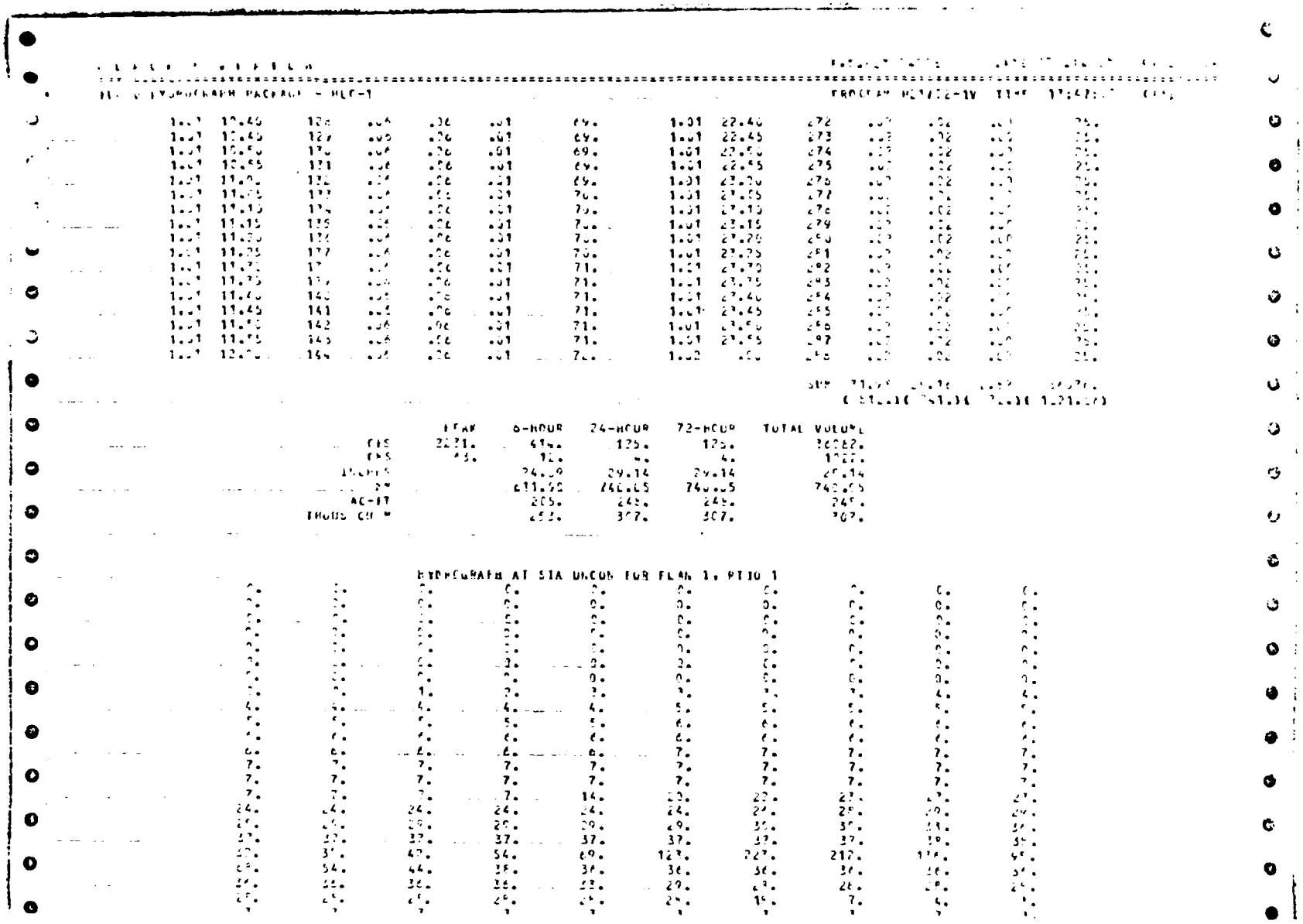
64.	51.	102.	56.	17.	6.	1.

END-OF-PERIOD FLOW

FLOW	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.00	.05	1	.01	.00	.01	0.	1.01	12.05	145	.21	.19	.02	195.
1.00	.10	2	.01	.00	.01	0.	1.01	12.10	146	.21	.19	.02	194.
1.00	.15	3	.01	.00	.01	0.	1.01	12.15	147	.21	.19	.02	193.
1.00	.20	4	.01	.00	.01	0.	1.01	12.20	148	.21	.19	.02	192.
1.00	.25	5	.01	.00	.01	0.	1.01	12.25	149	.21	.19	.02	191.
1.00	.30	6	.01	.00	.01	0.	1.01	12.30	150	.21	.19	.02	190.
1.00	.35	7	.01	.00	.01	0.	1.01	12.35	151	.21	.19	.02	189.
1.00	.40	8	.01	.00	.01	0.	1.01	12.40	152	.21	.19	.02	187.
1.00	.45	9	.01	.00	.01	0.	1.01	12.45	153	.21	.19	.02	186.
1.00	.50	10	.01	.00	.01	0.	1.01	12.50	154	.21	.19	.02	185.
1.00	.55	11	.01	.00	.01	0.	1.01	12.55	155	.21	.19	.02	184.
1.00	1.00	12	.01	.00	.01	0.	1.01	13.00	156	.21	.19	.02	183.
1.00	1.05	13	.01	.00	.01	0.	1.01	13.05	157	.21	.19	.02	182.

1.01	1.20	16	.01	.00	.01	6.	1.01	13.20	160	.25	.24	.01	290.
1.01	1.25	17	.01	.00	.01	6.	1.01	13.25	161	.25	.24	.01	292.
1.01	1.30	18	.01	.00	.01	6.	1.01	13.30	162	.25	.24	.01	293.
1.01	1.35	19	.01	.00	.01	6.	1.01	13.35	163	.25	.24	.01	295.
1.01	1.40	20	.01	.00	.01	6.	1.01	13.40	164	.25	.24	.01	296.
1.01	1.45	21	.01	.00	.01	6.	1.01	13.45	165	.25	.24	.01	298.
1.01	1.50	22	.01	.00	.01	6.	1.01	13.50	166	.25	.24	.01	299.
1.01	1.55	23	.01	.00	.01	6.	1.01	13.55	167	.25	.24	.01	300.
1.01	2.00	24	.01	.00	.01	6.	1.01	14.00	168	.25	.24	.01	302.
1.01	2.05	25	.01	.00	.01	6.	1.01	14.05	169	.25	.24	.01	303.
1.01	2.10	26	.01	.00	.01	6.	1.01	14.10	170	.25	.24	.01	305.
1.01	2.15	27	.01	.00	.01	6.	1.01	14.15	171	.25	.24	.01	306.
1.01	2.20	28	.01	.00	.01	6.	1.01	14.20	172	.25	.24	.01	308.
1.01	2.25	29	.01	.00	.01	6.	1.01	14.25	173	.25	.24	.01	309.
1.01	2.30	30	.01	.00	.01	6.	1.01	14.30	174	.25	.24	.01	311.
1.01	2.35	31	.01	.00	.01	6.	1.01	14.35	175	.25	.24	.01	312.
1.01	2.40	32	.01	.00	.01	6.	1.01	14.40	176	.25	.24	.01	314.
1.01	2.45	33	.01	.00	.01	6.	1.01	14.45	177	.25	.24	.01	315.
1.01	2.50	34	.01	.00	.01	6.	1.01	14.50	178	.25	.24	.01	317.
1.01	2.55	35	.01	.00	.01	6.	1.01	14.55	179	.25	.24	.01	318.
1.01	3.00	36	.01	.00	.01	6.	1.01	15.00	180	.25	.24	.01	320.
1.01	3.05	37	.01	.00	.01	6.	1.01	15.05	181	.19	.18	.01	317.
1.01	3.10	38	.01	.00	.01	6.	1.01	15.10	182	.19	.18	.01	319.
1.01	3.15	39	.01	.00	.01	6.	1.01	15.15	183	.19	.18	.01	320.
1.01	3.20	40	.01	.00	.01	6.	1.01	15.20	184	.19	.18	.01	322.
1.01	3.25	41	.01	.00	.01	1.	1.01	15.25	185	.66	.65	.01	1154.
1.01	3.30	42	.01	.00	.01	1.	1.01	15.30	186	1.01	1.00	.01	1772.
1.01	3.35	43	.01	.00	.01	1.	1.01	15.35	187	2.64	2.61	.03	4621.
1.01	3.40	44	.01	.00	.01	1.	1.01	15.40	188	1.04	1.03	.01	1826.
1.01	3.45	45	.01	.00	.01	1.	1.01	15.45	189	.66	.65	.01	1161.
1.01	3.50	46	.01	.00	.01	1.	1.01	15.50	190	.67	.66	.01	1165.
1.01	3.55	47	.01	.00	.01	2.	1.01	15.55	191	.38	.37	.01	654.
1.01	4.00	48	.01	.00	.01	2.	1.01	16.00	192	.38	.37	.01	655.
1.01	4.05	49	.01	.00	.01	2.	1.01	16.05	193	.29	.28	.00	496.
1.01	4.10	50	.01	.00	.01	2.	1.01	16.10	194	.29	.29	.00	498.
1.01	4.15	51	.01	.00	.01	2.	1.01	16.15	195	.29	.29	.00	500.
1.01	4.20	52	.01	.00	.01	2.	1.01	16.20	196	.29	.29	.00	501.
1.01	4.25	53	.01	.00	.01	2.	1.01	16.25	197	.29	.29	.00	503.
1.01	4.30	54	.01	.00	.01	3.	1.01	16.30	198	.29	.29	.00	504.
1.01	4.35	55	.01	.00	.01	3.	1.01	16.35	199	.29	.29	.00	506.
1.01	4.40	56	.01	.00	.01	3.	1.01	16.40	200	.29	.29	.00	507.
1.01	4.45	57	.01	.00	.01	3.	1.01	16.45	201	.29	.29	.00	509.
1.01	4.50	58	.01	.00	.01	3.	1.01	16.50	202	.29	.29	.00	510.
1.01	4.55	59	.01	.00	.01	3.	1.01	16.55	203	.29	.29	.00	512.
1.01	5.00	60	.01	.00	.01	3.	1.01	17.00	204	.29	.29	.00	513.
1.01	5.05	61	.01	.00	.01	4.	1.01	17.05	205	.23	.23	.00	326.
1.01	5.10	62	.01	.00	.01	4.	1.01	17.10	206	.23	.23	.00	327.
1.01	5.15	63	.01	.00	.01	4.	1.01	17.15	207	.23	.23	.00	329.
1.01	5.20	64	.01	.00	.01	4.	1.01	17.20	208	.23	.23	.00	330.
1.01	5.25	65	.01	.00	.01	4.	1.01	17.25	209	.23	.23	.00	331.
1.01	5.30	66	.01	.00	.01	4.	1.01	17.30	210	.23	.23	.00	333.
1.01	5.35	67	.01	.00	.01	4.	1.01	17.35	211	.23	.23	.00	334.
1.01	5.40	68	.01	.00	.01	4.	1.01	17.40	212	.23	.23	.00	336.
1.01	5.45	69	.01	.00	.01	5.	1.01	17.45	213	.23	.23	.00	337.





[illegible] WEATCH

[illegible] HYDROGRAPH PACKAGE - HEC-1

PROJECT [illegible] DATE 27 JAN 81 PAGE [illegible]

PROGRAM HEC1/2-1V TIME 17:47:[illegible]

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	423.	41.	13.	13.	3608.
CMS	6.	1.	0.	0.	102.
INCHES		0.41	2.91	2.91	2.91
MM		41.10	74.00	74.00	74.00
AC-FT		21.	25.	25.	2[illegible].
THOUS CU M		25.	31.	31.	31.

HYDROGRAPH AT STA UNCUS FOR PLAN 1, RTIO 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	375.	[illegible].	19.	19.	5432.
CMS	9.	2.	1.	1.	153.
INCHES		3.61	4.37	4.37	4.37
MM		91.79	111.01	111.01	111.01
AC-FT		31.	37.	37.	37.
THOUS CU M		38.	46.	46.	.

	214.17	259.02	259.02		259.02
AC-FT	72.	87.	87.		87.
THOUS CU M	88.	107.	107.		107.

HYDROGRAPH AT STA LACCA FOR PLAN 1, RTIO 7

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

BASE HYDROGRAPH PACKAGE - DEC-1 PROGRAM HEC1/22-1V TIME 13:47:52 CASE

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	2.	2.	2.	2.	2.	2.	2.	2.
2.	3.	5.	9.	11.	13.	17.	11.	14.	15.
16.	17.	17.	17.	18.	19.	19.	19.	19.	20.
21.	21.	21.	21.	22.	22.	22.	23.	23.	23.
23.	24.	24.	24.	24.	24.	25.	25.	25.	25.
25.	25.	26.	26.	26.	26.	26.	26.	26.	27.
27.	27.	27.	27.	27.	27.	27.	27.	28.	28.
28.	28.	28.	28.	28.	28.	28.	28.	28.	28.
28.	28.	29.	29.	54.	80.	89.	92.	93.	94.
94.	95.	95.	95.	96.	96.	104.	112.	113.	116.
117.	117.	117.	119.	119.	119.	119.	119.	120.	143.
147.	148.	149.	149.	149.	150.	150.	150.	150.	150.
147.	147.	169.	215.	274.	491.	592.	640.	645.	775.
224.	214.	177.	157.	144.	143.	141.	142.	142.	142.
142.	142.	142.	142.	139.	138.	134.	133.	132.	132.
132.	132.	132.	132.	132.	132.	71.	20.	12.	12.
11.	10.	10.	10.	10.	10.	10.	10.	10.	10.
10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
10.	10.	10.	10.	10.	10.	10.	10.	10.	10.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	852.	186.	56.	56.	1443.
CMS	25.	5.	1.	1.	40.
INCHES		4.04	11.65	11.65	11.65
MM		244.78	296.02	296.02	296.02
AC-FT		92.	99.	99.	99.
THOUS CU M		101.	123.	123.	123.

HYDROGRAPH AT STA LACCA FOR PLAN 1, RTIO 6

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	3.	7.	11.	13.	15.	16.	17.	19.	19.
19.	20.	21.	22.	22.	23.	23.	24.	24.	25.
25.	25.	26.	27.	27.	28.	28.	28.	28.	28.
28.	28.	29.	30.	30.	31.	31.	31.	31.	31.
32.	32.	32.	32.	32.	32.	32.	32.	32.	32.
32.	32.	34.	34.	34.	34.	34.	34.	34.	35.
35.	35.	35.	35.	35.	35.	35.	35.	35.	35.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1116.	207.	63.	63.	15041.
CMS	32.	6.	2.	2.	511.
INCHES		12.45	14.57	14.57	14.57
MM		305.59	370.02	370.02	370.02
AC-FT		1234.	1246.	1246.	1246.
THOUS CU M		122.	153.	153.	153.

HYDROGRAPH AT STA LAGOA FOR PLAN 1, RTIO 4

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CES	2231.	616.	125.	125.	36062.

H L A C K & V E A T C H PROJECT 9457: DATE 07 JAN 81 FILE ...

FLOOD HYDROGRAPH PACKAGE - HEC-1 PROGRAM H21/72-1V TIME 13:47:...

CMS	43.	16.	4.	4.	1027.
INCHES		2.49	29.14	29.14	29.14
HM		611.60	740.05	740.05	740.05
AC-FT		205.	248.	248.	248.
THOUS CU M		253.	307.	307.	307.

COMBINE HYDROGRAPHS

COMBINE HYDROGRAPHS

ISTA	ICOMP	ICODE	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	2	0	0	0	0	1	0	0

SUM OF 2 HYDROGRAPHS AT ESMED PLAN 1 RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CES	3504.	1232.	77.	77.	37672.
CMS	99.	35.	2.	2.	1067.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	350.	129.	97.	92.	13672.
CMS	10.	4.	3.	3.	388.
INCHES		3.61	3.45	3.45	3.45
MM		91.69	87.50	87.50	87.50

AC-FT	64.	73.	75.	77.
INCH EQUIV	79.	91.	91.	91.

SUM OF 2 HYDROGRAPHS AT DSHED PLAN 1 RTIO 2

1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	2.	2.	2.	2.	2.	2.
2.	2.	3.	4.	5.	5.	6.	6.	7.	7.
7.	7.	7.	8.	8.	8.	8.	9.	9.	9.
9.	9.	9.	10.	10.	10.	10.	10.	10.	10.
11.	11.	11.	11.	11.	11.	11.	11.	11.	11.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
13.	13.	13.	13.	13.	13.	13.	13.	13.	13.
13.	13.	13.	13.	13.	13.	13.	13.	13.	14.
14.	14.	14.	14.	23.	33.	36.	36.	36.	36.
64.	65.	66.	119.	128.	175.	223.	265.	295.	298.
296.	296.	296.	295.	295.	194.	178.	162.	154.	152.
150.	149.	146.	146.	144.	144.	143.	142.	140.	140.
139.	138.	142.	144.	154.	269.	423.	517.	469.	462.
274.	231.	207.	195.	208.	207.	191.	179.	169.	160.
154.	151.	146.	146.	128.	121.	126.	122.	119.	117.
115.	117.	112.	110.	109.	106.	92.	77.	65.	54.
47.	41.	34.	27.	26.	27.	24.	23.	21.	20.
19.	18.	17.	16.	15.	15.	14.	14.	13.	13.
13.	12.	12.	12.	12.	11.	11.	11.	11.	11.
11.	11.	10.	10.	10.	10.	10.	10.	10.	10.
10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
10.	10.	10.	10.	10.	10.	10.	10.	10.	10.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	517.	195.	53.	53.	15190.
CMS	15.	5.	1.	1.	430.
INCHES		4.29	4.91	4.91	4.91
MM		109.02	124.82	124.82	124.82
AC-FT		92.	105.	105.	105.
INCH EQUIV		113.	129.	129.	129.

SUM OF 2 HYDROGRAPHS AT DSHED PLAN 1 RTIO 3

1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.

SUM OF 2 HYDROGRAPHS AT DSHED PLAN 1 RTIO 2

1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	3.	3.	3.	3.	3.	3.	3.	3.	3.

HYDROGRAPH PACKAGE - HEC-1 PROGRAM HEC1/C2-1V TIME 13:47:52 CASE

7.	7.	8.	10.	12.	13.	14.	15.	16.	16.	
17.	18.	18.	19.	20.	20.	21.	21.	22.	22.	
23.	23.	24.	24.	24.	25.	25.	25.	26.	26.	
26.	27.	27.	27.	27.	28.	29.	29.	31.	44.	
64.	89.	115.	158.	208.	240.	275.	304.	334.	335.	
264.	219.	180.	155.	137.	127.	119.	106.	99.	99.	
99.	98.	97.	81.	80.	78.	77.	76.	76.	75.	
75.	69.	74.	74.	100.	131.	145.	163.	167.	158.	
145.	207.	214.	220.	224.	228.	240.	252.	260.	267.	
273.	276.	282.	286.	287.	290.	291.	293.	297.	297.	
297.	295.	289.	285.	280.	284.	287.	289.	291.	292.	
295.	297.	299.	441.	561.	765.	1159.	1456.	1756.	1335.	
1144.	974.	787.	652.	577.	514.	477.	440.	413.	402.	
370.	351.	335.	320.	354.	334.	344.	314.	304.	302.	
296.	292.	289.	287.	286.	286.	285.	184.	177.	130.	
113.	94.	81.	71.	63.	57.	52.	48.	46.	41.	
37.	37.	35.	34.	33.	33.	31.	30.	29.	29.	
27.	27.	27.	27.	27.	27.	27.	27.	27.	27.	
26.	26.	26.	26.	26.	26.	26.	26.	26.	26.	
25.	25.	25.	25.	25.	25.	25.	25.	25.	25.	
25.	25.	25.	25.	25.	25.	25.	25.	25.	25.	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1456.	459.	171.	171.	37269.
CMS	41.	13.	4.	4.	1056.
INCHES		6.50	12.21	12.21	12.21
MM		241.42	310.03	310.03	310.03
AC-FT		603.	339.	339.	739.
THOUS CU M		744.	419.	419.	911.

SUM OF 2 HYDROGRAPHS AT DSHED PLAN 1 RTIO 3

1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	3.	3.	3.	3.
3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
4.	4.	9.	12.	15.	16.	17.	18.	19.	20.	
21.	22.	23.	24.	24.	25.	26.	26.	27.	27.	
28.	29.	29.	30.	30.	30.	31.	31.	32.	32.	
33.	34.	35.	54.	74.	100.	128.	167.	219.	259.	
247.	217.	230.	251.	275.	225.	195.	169.	151.	137.	
123.	113.	112.	107.	103.	101.	98.	96.	95.	94.	
93.	92.	91.	91.	91.	91.	91.	90.	90.	90.	
90.	90.	90.	90.	124.	162.	166.	205.	237.	238.	
239.	239.	237.	237.	237.	237.	237.	237.	237.	236.	
236.	236.	236.	236.	261.	263.	265.	267.	444.	444.	
444.	444.	444.	444.	452.	454.	456.	467.	469.	469.	
469.	469.	469.	552.	557.	566.	1469.	1969.	2355.	1755.	
1754.	1754.	1754.	748.	751.	751.	751.	751.	751.	751.	

	225.	215.	207.	201.	447.	444.	199.	196.	194.	194.
	127.	119.	112.	107.	103.	101.	99.	96.	94.	94.
	93.	92.	91.	91.	91.	91.	90.	90.	89.	89.
	90.	90.	90.	90.	126.	102.	106.	245.	243.	235.
	251.	261.	270.	277.	283.	287.	301.	317.	327.	336.
	343.	346.	354.	356.	361.	363.	365.	367.	364.	404.
	419.	425.	435.	444.	453.	456.	466.	463.	465.	466.
	436.	449.	461.	452.	459.	564.	1949.	1943.	2035.	1944.
	1304.	1305.	516.	769.	669.	616.	569.	534.	524.	491.
	429.	420.	462.	459.	459.	617.	402.	390.	361.	323.

BLACK & VEATCH PROJECT 9457: DATE 07 JAN 81 PAGE 77

RESET HYDROGRAPH PACKAGE (HEC-1) PROGRAM H21/C2-1V TIME 12:47:12 FILE

208.	204.	200.	358.	356.	355.	249.	237.	161.	159.
117.	113.	97.	85.	75.	69.	61.	57.	57.	49.
47.	45.	43.	41.	40.	39.	39.	37.	36.	36.
35.	35.	34.	34.	34.	33.	33.	33.	33.	33.
32.	32.	32.	32.	32.	32.	32.	32.	32.	32.
32.	32.	32.	32.	32.	32.	32.	32.	32.	32.
32.	32.	32.	32.	32.	32.	32.	32.	32.	32.
32.	32.	32.	32.	26.	22.	32.	32.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2479.	511.	143.	143.	46837.
CMS	70.	14.	4.	4.	1326.
INCHES		11.89	15.13	15.13	15.13
MM		302.10	384.26	384.26	384.26
AC-FT		254.	323.	323.	923.
TRUES CU M		343.	398.	398.	399.

SUM OF 2 HYDROGRAPHS AT USHED PLAN 1 RTIO 9

1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	2.	2.	2.	2.	2.	2.	2.	2.	2.
3.	3.	4.	4.	4.	4.	4.	4.	4.	4.
5.	5.	5.	5.	5.	5.	6.	6.	6.	6.
6.	7.	15.	24.	28.	31.	34.	36.	39.	40.
41.	43.	44.	46.	47.	49.	50.	51.	56.	76.
155.	135.	154.	179.	207.	233.	242.	246.	261.	467.
423.	343.	296.	260.	235.	217.	204.	194.	187.	181.
177.	175.	173.	171.	170.	170.	169.	169.	169.	169.
172.	172.	171.	171.	171.	172.	172.	173.	173.	174.
174.	174.	174.	174.	174.	177.	177.	178.	179.	179.
179.	179.	180.	180.	242.	345.	379.	424.	462.	495.
541.	541.	557.	570.	579.	584.	613.	643.	666.	672.
676.	703.	714.	743.	768.	783.	795.	795.	770.	514.
543.	567.	586.	601.	613.	920.	924.	931.	934.	936.
974.	995.	966.	1167.	1319.	2003.	3995.	5040.	4152.	3044.
2247.	1735.	1394.	1217.	1124.	1067.	1017.	976.	937.	911.
919.	917.	916.	910.	905.	901.	792.	768.	755.	739.
726.	719.	714.	710.	708.	706.	594.	457.	454.	596.
240.	194.	177.	147.	149.	116.	106.	98.	93.	88.
83.	79.	74.	74.	72.	71.	70.	69.	69.	67.
64.	64.	64.	65.	65.	67.	64.	64.	64.	64.
64.	64.	64.	64.	67.	67.	67.	67.	67.	67.
67.	67.	67.	67.	67.	67.	67.	67.	67.	67.
67.	67.	67.	67.	67.	67.	67.	67.	67.	67.
67.	67.	67.	67.	67.	67.	67.	67.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5040.	1026.	286.	286.	93675.
CMS	143.	29.	8.	8.	2653.

FEDS HYDROGRAPH PACKAGE - HEC-1 PROGRAM HEC1/C2-1V TIME 17:47:02 CASE

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	895.00	895.00	954.00
STORAGE	63.	63.	1100.
OUTFLOW	0.	0.	100.

UPPER DONIPHAN DAM

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	896.03	.03	80	149.	.00	16.50	.00
.15	896.29	.03	104.	153.	.00	16.67	.00
.20	896.24	.26	114.	206.	2.00	16.75	.00
.25	896.57	.57	126.	330.	3.75	16.83	.00
.30	896.80	1.80	138.	526.	3.17	16.08	.00
.35	896.73	1.73	133.	875.	3.50	15.92	.00
.40	896.94	1.94	135.	1152.	4.08	15.83	.00
.45	896.26	2.26	140.	1796.	4.92	15.67	.00
1.00	897.24	3.24	153.	4455.	6.92	15.75	.00